Protecting the integrity of Montana's water bodies from degradation caused by invasive aquatic plants

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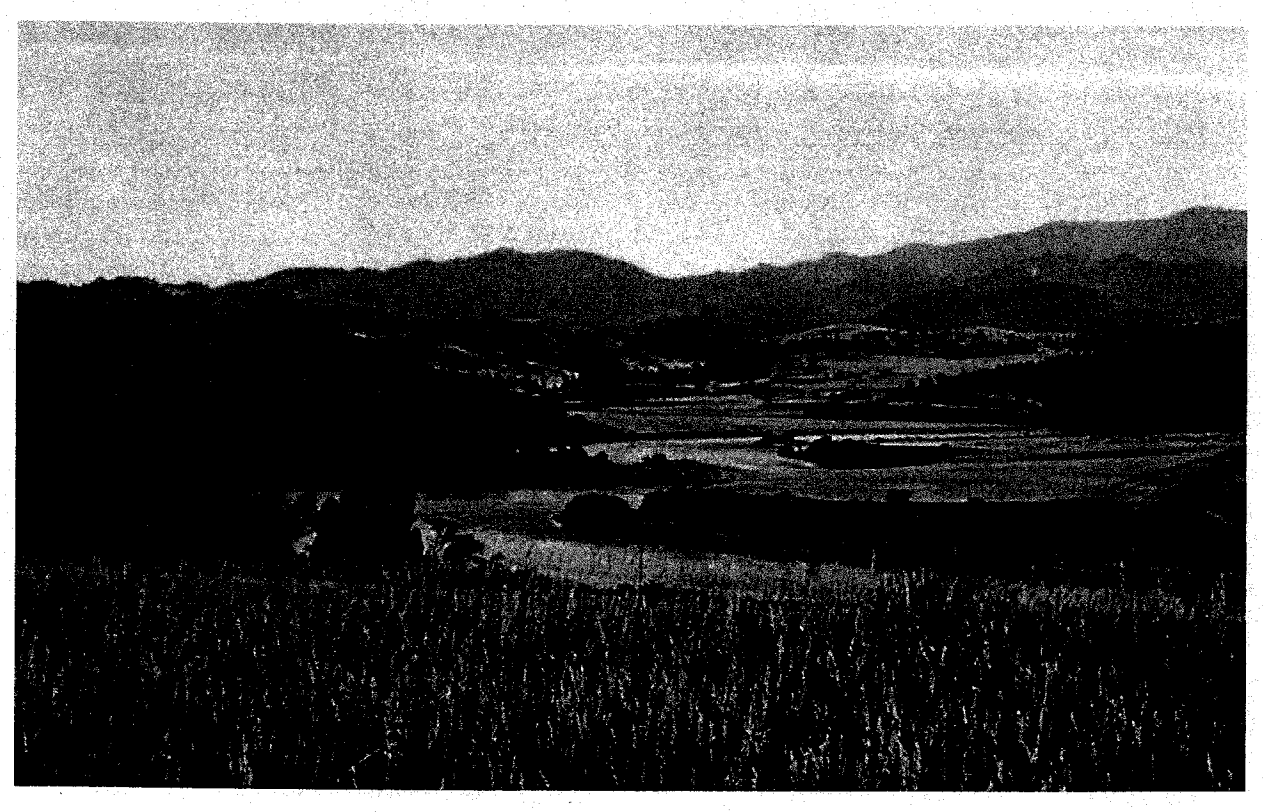
revision 1

2011

MONTANA'S STATEWIDE STRATEGIC PLAN FOR INVASIVE AQUATIC PLANT MANAGEMENT AND RESOURCE PROTECTION



MONTANA NOXIOUS WEED SUMMIT
ADVISORY COUNCIL AND OVERSIGHT COMMITTEE

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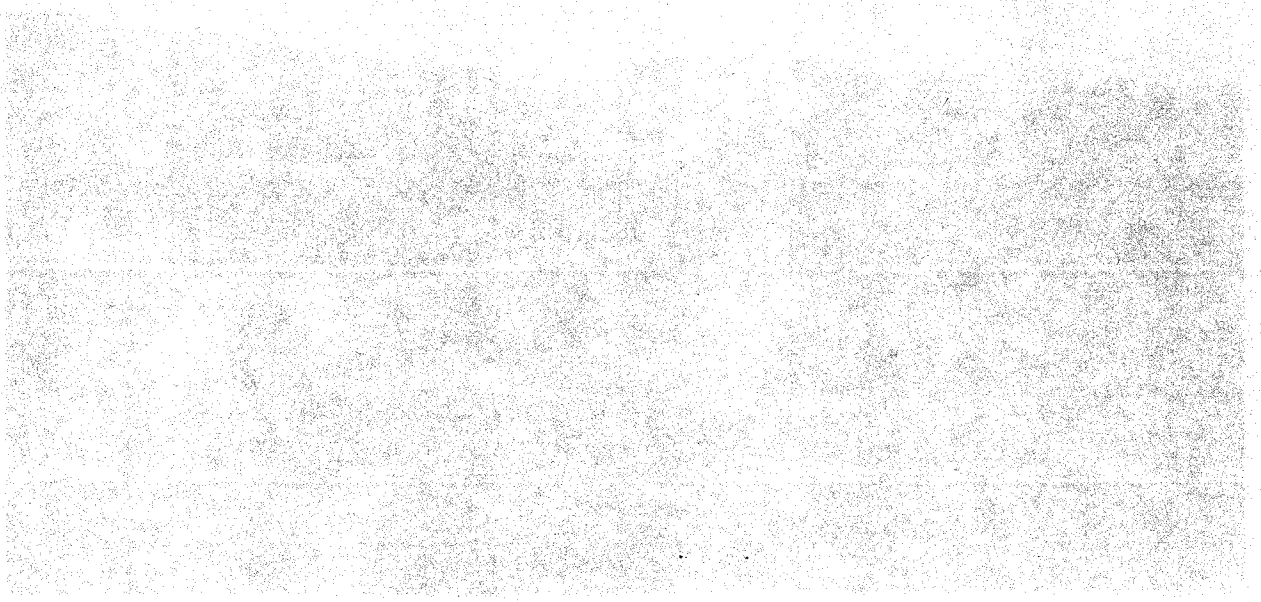

EXECUTIVE SUMMARY

Invasive aquatic plants threaten the ecological integrity of aquatic environments in Montana. Eurasian watermilfoil (*Myriophyllum spicatum*), curly-leaf pondweed (*Potamogeton crispus* L.), and flowering rush (*Butomus umbellatus*) are established in the state, and there is a high risk of invasion by other non-native aquatic plants. These plants are highly competitive in northern environments and have the potential to impact fisheries, native aquatic plant communities, and impair water control structures, power generation, and irrigation by clogging infrastructure. In addition, increased aquatic plant biomass impacts water quality (nutrient loading) and recreational resources.

The purpose of this plan is to provide a statewide framework and strategy for Montana stakeholders to protect aquatic resources, manage invasive aquatic plants, and provide guidance and direction to on-ground managers. This plan was developed and supported by invasive plant managers in Montana including state, federal, county, and private stakeholders. The Noxious Weed Summit Advisory Council has responsibility for identifying and supporting leaders for action items identified within this plan. These leaders will provide local and statewide direction and organization to facilitate aquatic plant management programs in Montana.

Financial resources are currently inadequate to prevent new introductions of invasive aquatic plants to non-infested water bodies in the state, or contain and control existing infestations. It is calculated that about $1.5 million dollars annually is needed for outreach/education, prevention, monitoring, containment and control of existing infestations.

Expected results and estimated cost to implement components of this plan are as follows:

- **Leadership:** Provide statewide technical support, coordination, and direction for managing invasive aquatic plants in Montana ($125,000/yr coordinator and technician and operations).
- **Public Awareness and Education:** Expand public outreach and education programs on invasive aquatic plants ($88,000/yr).
- **Prevention:** Prevent introduction and establishment of invasive aquatic plants to non-infested water bodies in Montana ($545,000/yr).
- **Early Detection and Rapid Response:** Expand surveys of water bodies for invasive aquatic plants and eradicate or control new populations ($290,000/yr).
- **Management:** Reduce existing invasive aquatic plant populations in Montana by implementing science-based containment and control programs ($310,000/yr).
- **Restoration and Rehabilitation:** Decrease susceptibility of aquatic environments to invasion by invasive aquatic plants ($30,000).
- **Research and New Technology:** Support research projects that develop solutions to protect non-infested water bodies, manage existing infestations, and enhance functional aquatic environments ($150,000/yr).

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INDEX TO ABBREVIATIONS AND ACRONYMS

AIS	Aquatic Invasive Species
ANS	Aquatic Nuisance Species
BMP	Best Management Practices
BOR	USDI Bureau of Reclamation
CAPS	USDA Cooperative Agriculture Pest Survey Program
CLP	Curlyleaf pondweed
CS&KT	Confederated Salish and Kootenai Tribe
CWD	County Weed District
DEQ	Montana Department of Environmental Quality
DNRC	Montana Department of Natural Resources and Conservation
EA	Environmental Assessment
EDRR	Early Detection and Rapid Response
EPA	Environmental Protection Agency
FAS	Fishing Access Sites
EWM	Eurasian watermilfoil
FWP	Montana Fish, Wildlife and Parks
GPS	Global Positioning System
MCA	Montana Codes Annotated
MDA	Montana Department of Agriculture
MOU	Memorandum of Understanding
MPDES	Montana Pollutant Discharge Elimination System
MSU	Montana State University
PGP	Pesticide General Permit
UM	University of Montana
USACE	United State Army Corps of Engineers

Chapter 1. Purpose and Need for Action

INTRODUCTION

Invasive aquatic plants threaten the ecological integrity of aquatic environments in Montana. Plants such as Eurasian watermilfoil (*Myriophyllum spicatum*), curly-leaf pondweed (*Potamogeton crispus* L.), and flowering rush (*Butomus umbellatus*) are highly competitive in northern environments, and are capable of out-competing native aquatic plants or vegetating substrates that were historically devoid of aquatic vegetation (Appendix K). Invasive aquatic plants have the potential to impact fisheries and impair water control structures, power generation, and irrigation by clogging infrastructure. In addition, increased aquatic plant biomass impacts water quality (nutrient loading) and recreational resources.

The purpose of this document is to provide a statewide framework and strategy for Montana stakeholders to manage *invasive aquatic plants*[1] and protect aquatic resources. This plan will focus on management of submersed and partially emerged invasive aquatic plants. Riparian areas in Montana are also impacted by noxious weeds such as yellow flag iris (*Iris pseudacoru*), purple loosestrife (*Lythrum salicaria* L.), tamarisk (*Tamarix* spp.) and plants in the knotweed complex (*Polygonum* spp.). However, these weeds typically grow along the water's edge and management methods are different than for true aquatic plants.

Management authority for invasive aquatic plants in Montana is the responsibility of county weed districts (CWDs) and Montana Department of Agriculture (MDA). County weed districts have jurisdiction over aquatic noxious weeds through the County Noxious Weed Control Act (7-22-2101 et seq., MCA). Counties may also enter into agreements with MDA for control and eradication of new exotic plant species not previously established in the state (7-22-2109[d]). The Montana Weed Control Act (80-7-701 et. seq., MCA) gives MDA authority to provide technical assistance and other services to local governments such as CWDs on management and control of noxious weeds.

GOAL

The overall goal of this plan is to **protect the integrity of Montana's water bodies from degradation caused by invasive aquatic plants by:**

1. Maximizing prevention of new invasions
2. Enabling early detection and rapid response
3. Ensuring that the response to new or existing invasions includes science-based approaches to contain, reduce or eradicate populations

OBJECTIVES

This plan outlines action items and guides procedures to contain and control existing invasive aquatic plant infestations and protect non-infested water bodies in Montana. An integrated management approach is proposed that supports components described in the Montana Weed Management Plan (2008). Objectives

[1] Invasive aquatic plants include those that are not native to the United States but may or may not be defined as noxious in Montana.

for each component of the integrated program are described below. Expected results, action items, leadership, funding, and timeframes to obtain these objectives are described in Chapter 3: Plan of Action.

I. **Leadership:** Provide statewide technical and financial support, coordination, and direction for managing invasive aquatic plants in Montana.

II. **Public Awareness and Education:** Expand public outreach and education programs on invasive aquatic plants.

III. **Prevention:** Prevent introduction and establishment of invasive aquatic plants to non-infested water bodies in Montana.

IV. **Early Detection and Rapid Response:** Expand inspection/surveys of water bodies for invasive aquatic plants and eradicate or control populations.

V. **Management:** Reduce existing invasive aquatic plant populations in Montana by implementing science-based containment and control programs.

VI. **Restoration and Rehabilitation:** Decrease susceptibility of aquatic environments to invasion by invasive aquatic plants.

VII. **Research and New Technology:** Support research projects that develop solutions to protect non-infested water bodies, manage existing infestations, and enhance functional aquatic environments.

VIII. **Adaptive Management:** Measure and analyze effectiveness of action items and modify management decisions to meet program objectives.

LEGISLATION AND DIRECTIVES RELATED TO INVASIVE AQUATIC PLANTS

FEDERAL DIRECTION

Executive Order and National Invasive Species Management Plan

President Clinton issued Invasive Species Executive Order 13112 in 1999 calling on Executive Branch agencies to prevent and control introduction and spread of invasive species. The Order established the National Invasive Species Council, which is chaired by Secretaries of Agriculture, Commerce, and Interior and includes Departments of State, Treasury, Defense, Health and Human Services, Transportation, Environmental Protection Agency, and the U.S. Agency for International Development. The Order builds on the National Environmental Policy Act of 1969, the Federal Noxious Weed Act of 1974, and the Endangered Species Act of 1973 to prevent introduction of invasive species, provide for their control, and take measures to minimize economic, ecological, and human health impacts. The National Invasive Species Management Plan provides a blueprint for federal action for invasive species in coordination with international, state, local, and private programs.

Section 1204 State Aquatic Nuisance Species (ANS) Management Plans

Section 1204 of the National Invasive Species Act (1996) allowed for development, public review, and submission of a comprehensive ANS management plan. The Montana ANS plan was completed and

published in 2002. The state ANS plan is briefly described under "state direction" below and a copy of the plan is on file with Montana Fish, Wildlife and Parks (FWP).

STATE DIRECTION

Montana Weed Laws

The first noxious weed legislation in Montana was passed in 1939. Since then additional laws and rules have been enacted to strengthen weed management efforts. Laws currently affecting weed management in Montana are summarized in Appendix B, and can be viewed in their entirety at www.mt.gov or http://data.opi.mt.gov/bills/mca_toc/index.htm.

Montana Aquatic Invasive Species Act

Senate Bill No. 343 passed the Montana Legislature in 2009 creating the Montana Aquatic Invasive Species Act. The Act established an invasive species account and defined responsibilities of MDA and Montana Fish, Wildlife and Parks (FWP) for managing aquatic invasive species in Montana. A summary of the cooperative agreement between MDA and FWP outlining agency responsibilities is shown in Appendix A. The Act allows for designation of an invasive species management area for control and protection of specific areas of land, bodies of water, or the entire state from the introduction and/or spread of specific aquatic invasive species. Once an invasive species management area is defined, the Act states that the MDA shall establish a check station within or adjacent to the area to prevent introduction, importation, infestation, and spread of the invasive species. In addition, MDA shall work cooperatively with any affected land managers and landowners within the boundaries of the designated area to establish prevention, treatment, control, and eradication methods best suited for the invasive species infesting or threatening the area (Sec 9[1]). Prevention may include public education, inspection, and prohibitions on transfer and transporting aquatic species within designated management areas.

Montana Aquatic Nuisance Species (ANS) Plan

The Montana ANS plan was completed by the Montana ANS technical committee and approved by the National ANS Task Force in 2002. The plan was developed to provide a management framework, objectives, and action items to prevent and reduce impact of ANS, including non-native aquatic plants, in Montana. The goal of the plan is to minimize harmful ecological, economic, and social impact of ANS through prevention, and management of introduction, spread, and dispersal into, within, and from Montana. Objectives of the plan include: 1) coordinate and implement a comprehensive ANS management plan; 2) prevent introduction of ANS into Montana; 3) detect, monitor, and eradicate pioneering aquatic invasive species; 4) where feasible, control and eradicate established ANS that have significant impact; 5) inform the public, policy makers, natural resource workers, private industry, and user groups about risks and impact of ANS; and 6) increase and disseminate knowledge of ANS in Montana through compiling data and conducting research. Development of the plan qualified the state for matching federal funds to conduct some activities detailed in the plan. The Montana ANS coordinator position with FWP is the result of state and federal adoption of the ANS plan.

Noxious Weed List and Categories

As of this writing, there are 32 designated noxious weeds in Montana that are divided into five priorities based on number of acres infested in the state and management criteria. A description of the noxious

weed prioritization and the 32 weeds on the statewide list are described in The Montana Weed Management Plan (2008). Aquatic plants listed as noxious weeds include Eurasian watermilfoil, curlyleaf pondweed, and flowering rush, which are classified as Priority 1B noxious weeds in Montana. Priority 1B includes weeds that have limited presence in Montana. Management criteria include public awareness and education, early detection, and immediate action to eradicate or contain infestations. Hydrilla is listed as a Priority 3 plant (not a noxious weed). County weed districts have authority over management of noxious weeds through the County Noxious Weed Control Act (7-22-2101 et seq., MCA).

Montana Weed Management Plan

The Montana Weed Management Plan was updated in 2008 to provide a framework and recommendations for actions to prevent introduction and manage spread of noxious weeds in Montana. The plan incorporates management of noxious weeds, including invasive aquatic plants, to complement regional and national strategies.

COUNTY DIRECTION

Montana County Weed Control Act (7-22-2101 et seq., MCA)

County weed districts implement and enforce the Montana County Weed Control Act. In addition, they also conduct weed education and awareness programs, develop cooperative agreements, coordinate weed management activities within and among counties, and monitor weed infestations on private and public lands. County weed management plans provide guidelines for compliance with the Montana County Weed Control Act, Title 7, Chapter 22, Sections 7-22-2101 through 7-22-2153, MCA, and provide a framework for effective noxious weed management[2].

Public and private entities that have noxious weeds present on their property (including aquatic plants on the statewide noxious weed list) are required to develop a noxious weed management plan and to have the plan approved by county weed boards as well as providing a biennial report on weed management activities.

[2] Online: http://data.opi.mt.gov/bills/mca_toc/7_22_21.htm

Chapter 2. Management Methods and Permit Requirements[3]

Treatment methods for invasive aquatic plant control should be selected based on site-specific conditions, and project goals and objectives. Available management techniques are described briefly in this section. More detailed information can be found in the following references: Gettys et al. 2009, Madsen 2005, Washington Department of Ecology Aquatic Plant Management Methods [online], U.S. Army Corps of Engineers Technical Report ERDC/EL MP-00-1. Cost of various treatments is shown in Appendix J.

PERMITTING PROCESS

Permits are required for any activity that causes turbidity in state waters or for application of herbicides. The following information discusses permits required for various aquatic plant management methods.

BOTTOM BARRIERS, EXCLUSION BARRIERS (IN WATER COLUMN), DIVER-OPERATED SUCTION, AND MANUAL REMOVAL TECHNIQUES

Activities in water that cause turbidity will require a 318 authorization from Department of Environmental Quality (DEQ). There is currently a review fee by DEQ. However, as of this writing, FWP fisheries biologist can issue a 318 authorization on behalf of DEQ without the fee (based on MOU between FWP and DEQ). The fisheries biologist and applicant sign the authorization, and approval is up to discretion of the biologist usually with "same day" approval. A 124 permit issued by FWP is also needed for government (county or state) directed projects. If the project is privately directed then a 310 permit (rather than 124 permit) issued by the appropriate conservation district may be required for diver-suction operations. A 404 permit from Army Corp of Engineers may also be required for diver-suction operations depending on the water body involved in treatment. More information about permitting can be found on agency web sites or by contacting agencies directly.

HERBICIDE APPLICATION FOR AQUATIC PLANT CONTROL

For surface waters excluding Indian Reservations, a 308 authorization from DEQ is required for herbicide applications made directly to water encompassing **less than 64 acres in size annually**. There is a $250 review fee with a 30 to 60 days approval period. However, DEQ can issue approval within two weeks for emergencies (based on staff schedule). DEQ will complete a checklist Environmental Assessment (EA) as part of approval of 308 authorization. Herbicide treatments directly to water that will be **greater than 64 acres annually** will require a Montana Pollutant Discharge Elimination System (MPDES) pesticide general permit. In accordance with federal requirements in the Clean Water Act, the DEQ Water Protection Bureau is in the process of developing a general permit for application of pesticides (including herbicides for aquatic weed control) to state surface waters. The DEQ has until April 9, 2011 to issue a final MPDES pesticide general permit (PGP) for pesticide applications. The Environmental Protection Agency (EPA) has drafted a federal pesticide general permit that will regulate application of pesticides to surface water in all Indian Reservations within the State of Montana. For all other surface waters of the state, Montana DEQ is required to develop a MPDES PGP that is as stringent as the federal PGP but will

[3] Information within this chapter is based on best available knowledge as of January 1, 2011, and should be reviewed and revised every two years.

incorporate state-specific issues. One notable exception is that irrigation return water and irrigation storm water runoff is not a regulated activity under the Clean Water Act and will be exempt from this program. The DEQ is working closely with MDA and stakeholders to meet the April 9, 2011 deadline. Additional information is available at http://deq.mt.gov/wqinfo/mpdes/default.mcpx.

MANAGEMENT

PREVENTION

Institutional controls include a combination of regulations that prevent transport of invasive aquatic plants through legislation and public education. These controls help reduce spread of problematic species by implementing quarantine and other legal requirements. Turions, rhizomes, and plant fragments can be carried on boats, trailers, motors, and fishing gear from one water body to another, thus proper prevention techniques are essential to curb the spread of aquatic plants. Vigilant monitoring, early detection, and rapid response to control newly invading plants are key to preventing widespread infestations. Watercraft inspection stations that allow for inspection of watercraft combined with removal of plant fragments are critical to stop movement from infested areas to non-infested water bodies. Chemical treatments on watercraft are only necessary for bilge tanks and other areas where water can collect if the objective is to remove invasive algae and veligers[4] in addition to plants (Madsen personal communication).

BIOLOGICAL CONTROL

A number of biological control organisms have been studied for invasive aquatic plants. To date, there are no effective agents available on an operational scale for aquatic plants established in Montana. Biological organisms for Eurasian watermilfoil include grass carp, pyramid moth (*Acentria nivea*), milfoil weevil (*Euhrychiopsis lecontei*), and a pathogen (*Mycoleptodiscus terrestris*). Because grass carp do not prefer Eurasian watermilfoil (Madsen 2005) and are a prohibited species in Montana because of their significant effects on aquatic ecosystems (Peter Ryce personal communication), they will not be considered as a management tool in Montana. The milfoil weevil (Madsen et al. 2000) and a native pathogenic fungus (*Mycoleptodiscus terrestris*) (Nelson and Shearer 2002) have both shown promise for management but are still under development. Although the milfoil weevil has been associated with a number of Eurasian watermilfoil declines (Creed and Sheldon 1994), there is no scientific basis to suggest that the insect will control Eurasian watermilfoil other than with continual augmentation of the population (Madsen personal communication). In addition Minnesota, Vermont, Wisconsin, and Washington have conducted research and development programs with the weevil, and all but Washington have abandoned them because they are not cost-effective or workable on an operational scale. The weevil is known to be present in northern Idaho and is suspected to be present in the Clark Fork River. As of this writing, there are no biological agents for curly-leaf pondweed and flowering rush.

HERBICIDES

The use of herbicides for managing aquatic plants has changed in the past 20 years due to increased concern about safety of pesticides, particularly products used in water. Currently, a product cannot be labeled for aquatic use if it poses more than a one-in-a-million chance of causing significant damage to

[4] A veliger is the free-swimming, planktonic larva of many kinds of marine and fresh-water gastropod mollusks and some bivalves (such as zebra mussel).

human health, the environment, or wildlife resources. In addition, it may not show evidence of biomagnification[5], bioavailability[6], or persistence in the environment.

Herbicides labeled for aquatic use can be classified as either contact or systemic. Contact herbicides act on the tissues contacted directly by the herbicide, typically causing extensive cellular damage at the point of uptake but not affecting areas untouched by the herbicide. These herbicides are typically faster acting but in many cases do not kill root crowns, roots, or rhizomes. In contrast, systemic herbicides are translocated throughout the plant. They are slower acting but often result in mortality of the entire plant (Madsen 2000).

The most commonly used herbicide compounds for invasive aquatic broadleaf plants (dicots) are systemic and include 2,4-D, triclopyr, and fluridone. Both 2,4-D and triclopyr act as selective plant growth regulators; fluridone acts by disrupting carotenoid synthesis, causing bleaching of chlorophyll. Both triclopyr and 2,4-D are specific toward broadleaf plants and will not target monocots such as pondweeds. The greatest impact on native vegetation would likely be to the well-established native milfoils within the system. Contact herbicides diquat and endothall may be used on small infestations of either invasive aquatic monocots or dicots, along shorelines as a "spot" treatment. The toxicity of endothall to aquatic organisms depends on the formulation used. The amine salt formulation is more toxic to fish than the dipotassium salt formulation (i.e., Aquathol K® or Aquathol Super K ®). The later two herbicides are not toxic to aquatic organisms at recommended rates of 0 to 5.5 ppm. The combination of a broadleaf herbicide triclopyr with endothall may reduce contact time and increase control of some invasive aquatic plants such as Eurasian watermilfoil (Madsen personal communication). Herbicide contact time and application rates for effective control of various invasive aquatic plants are described in Appendix I.

Application to submersed aquatic plants involves treating the water with an herbicide and allowing plants to take up herbicide from the water. Understanding exchange rate of the water is critical for successful application because it determines exposure time of the plant to the herbicide (Getsinger et al. 1991, Madsen 2000). Response of different plant species to different herbicides is a function of properties of both the plant and the herbicide. It is also important to match an herbicide with the appropriate concentration and exposure-time relationship for the target species (Netherland 1991).

MANUAL/MECHANICAL

In general, mechanical removal of invasive aquatic plants with harvesters, rotovators, or other mechanical equipment is not recommended in Montana. It is typically considered only when the plant has become widespread within a water body. Mechanical techniques usually result in plant fragmentation, which exacerbates spread. For mechanical removal to be effective all rhizome, turion, and plant fragments must be collected and disposed of properly. Tables in Appendix H discuss advantages and disadvantages of manual/mechanical methods.

Hand removal

Hand harvesting or hand implements may be appropriate control methods on small segments of shoreline. Hand pulling and removal of rooted submersed plants is labor intensive, but can be effective on small populations. Plants must be removed from the site and disposed where they cannot contact the water. No

[5] The increase in concentration of a substance that occurs in a food chain as a consequence of persistence, food chain energetics, or low rate of internal degradation or excretion of the substance.

[6] The degree to which or rate at which a substance is absorbed or becomes available at the site of physiological activity after administration.

specialized equipment is required in water less than three feet, but snorkeling equipment or SCUBA gear is necessary in deeper waters. Sediment type, visibility, and ability to remove the entire plant, including roots, determine success of hand removal control methods. Advantages of hand-pulling include immediate clearing of the water column with low environmental impact. Disadvantages include high cost and reduced visibility from the digging process, which interferes with divers' ability to detect plants.

Dredging

Diver dredging is a mechanical control technology for invasive aquatic plant removal that was pioneered by the British Columbia Ministry of Environment. During diver dredging operations, divers use venturi pump systems (small gold mining dredges) to suction plants and roots from the sediment. The pumps are mounted on barges or pontoon boats and the diver uses their hand, or hand held tools with a cutter head, to remove plants from sediment. Plants are vacuumed through the hose to the support vessel where plants are retained in a basket and sediment and water are discharged to the waterbody. Often a silt curtain is deployed around the treatment site to control turbidity This method can be effective depending on sediment condition, density of aquatic plants, and underwater visibility. Early, low-level infestations can be effectively controlled with dredging.

PHYSICAL CONTROL

Physical control methods for invasive aquatic plants include use of shading materials to reduce light available to plants and water level drawdown.

Bottom (benthic) barriers

Benthic barriers are natural or synthetic sheets or barriers applied over the lake bottom to prevent plants (invasive and native) from growing. Barriers are effective on localized, small-scale infestations where exclusion of vegetation is desired such as around docks, boat launches, or high-use public beaches. Attributes include total vegetation control at specific sites with no damage to areas outside the barrier zone. Disadvantages of barriers include control of all vegetation including desirable natives, expensive if used on a large-scale, labor-intensive installation, limited material durability, possible suspension due to water movement or gas accumulation beneath material, and annual maintenance of bottom barrier material to remove accumulations of silt and rooting plant fragments. Follow-up maintenance is essential to ensure success with bottom barriers. Diver and surface inspections should continue periodically during the growing season. Tables in Appendix H discuss advantages and disadvantages of benthic barriers.

Water level drawdown

For reservoirs where water levels can be regulated, water level drawdown and exposure to prolonged freezing temperature has effectively reduced or suppressed some aquatic plants such as Eurasian watermilfoil. Effectiveness is determined by level and duration of drawdown, presence of springs, and temperature. Drawdown is most effective when the entire depth range of the target species is exposed for at least one month to ensure thorough drying or freezing (Cooke 1980). Drawdown can have long-term effects (two or more years) and would not have to be applied on an annual basis. However, it does have significant impacts on the aquatic environment (Madsen 2000), such as fish habitat and native aquatic vegetation, potentially providing opportunity for "weedy" species to spread. Water level drawdown may also interfere with the function of the reservoir including power generation and recreation. Drawdown is not recommended in water bodies containing flowering rush as it may favor its establishment (Rice personal communication).

Chapter 3. Plan of Action—Integrated Management Strategies

This comprehensive plan includes seven major management components and identifies leadership, funding, and timeframes needed to meet goals and objectives of the invasive aquatic plant program in Montana. Action items are identified to meet expected results of each component.

I: LEADERSHIP

Statewide leadership for invasive aquatic plants is a critical component of this plan and will guide program implementation.

Expected Result

Provide statewide guidance and direction for managing invasive aquatic plants in Montana.

Action Item I-1

Hire an invasive species coordinator with an advanced university degree and expertise in aquatic plant ecology/biology and management. The position will be at an administrative or program manager level and will provide statewide leadership for the invasive aquatic plant program including:

- Facilitate implementation of the invasive aquatic plant management plan.
- Facilitate and coordinate watercraft inspection stations and provide quality control.
- Provide training and technical expertise to county weed districts, Tribes, federal and state agencies, and other stakeholders.
- Provide recommendations on best management practices in consultation with the technical advisory committee (see Action Item I-2).
- Coordinate inventory, monitoring, management, and rapid response actions.
- Coordinate/support volunteer monitoring programs.
- Serve as lead for a rapid response team.
- Facilitate communication between FWP ANS coordinator, MDA, and Montana Noxious Weed Summit Advisory Committee.
- Develop cooperative agreements between key stakeholders.
- Write grants to secure outside funds for program implementation and expansion.
- Research aquatic invasive plants that are a threat to Montana for inclusion on the Noxious Weed list.

Lead: Montana Department of Agriculture; Montana Fish, Wildlife and Parks

Funding: $125,000/yr including office, travel, rent, invasive species coordinator and technician, invasive species inspectors and other operations.

Time frame: May 2011

Action Item I-2

Establish a technical advisory committee to provide guidance/oversight on aquatic plant management. Advisory committee members would be required to have expertise related to aquatic invasive plant species. Members would serve as a sub-committee of the Montana Noxious Weed Summit Advisory Council.

- Establish selection criteria and agency/organization(s) in charge of selecting committee.

Lead: Montana Department of Agriculture; Montana Noxious Weed Summit Advisory Council

Funding: Provided from Advisory Council budget

Time frame: May 2011

Action Item I-3:

Identify and secure funding to implement components within this plan

- Work with legislators and stakeholders in Montana to create a Montana Aquatic Invasive Species Trust Fund to provide financial support for invasive aquatic projects.
- Increase funding to lead agencies through the Montana Aquatic Invasive Species Act.
- Work with congressional delegation to direct federal Aquatic Invasive Species (AIS) funding into the state and to agencies within the state (e.g., USACE).
- Work with the utility industry to secure funds in areas where they have dam operations.

Lead: Flathead Basin Commission, Center for Aquatic Nuisance Species, Montana Weed Control Association, and Healthy Habitat Coalition.

Funding: Total of about $1.5 million needed annually to meet plan objectives; does not include cost of Environmental Assessments

Time frame: January through April 2011

II. Public Awareness and Education

Public education is a key component of The Montana Weed Management Plan (2008) and the Montana Aquatic Invasive Species Act (SB343). Early detection and treatment of invasive aquatic plants, and an effective prevention program is dependent on education.

Expected Results

1. Public awareness of invasive aquatic plants in Montana is increased.
2. Training and involvement of public and private entities on aquatic plant identification is expanded.
3. Volunteer monitoring programs are established statewide.
4. Public knowledge and acceptance of aquatic plant management techniques are expanded.
5. The number of introductions of new invasive aquatic species into the state or areas within the state is reduced.

6. Early detection of invasive aquatic plants is increased, which will facilitate eradication and preventing widespread establishment.

Action Item II-1

Support/expand state-wide and regional public outreach "Inspect, Clean, Drain and Dry" campaign.

- Coordinate campaign message with regional and local efforts to maintain consistency among states.
- Develop a multi-venue media plan.
- Utilize focus group testing companies and pre- and post-survey results to assist in refining message.

Lead: Montana Fish, Wildlife and Parks; Montana Department of Agriculture

Funding: $50,000/year

Time frame: on-going

Action Item II-2

Develop, conduct, and support training on invasive aquatic plants for county weed districts, conservation districts and others.

- Identify training needs for local leadership including conservation and irrigation districts, watershed groups, and other governmental and non-governmental groups.
- Conduct periodic training with focus on plant identification, reporting procedures, and high risk sites for monitoring.
- Develop volunteer monitoring programs and standard operating procedures for both field and lab protocols.
- Provide training and direction for reporting invasive aquatic plants with EDDMaps statewide alert system.
- Develop county/watershed-level campaigns and advertisements that could be used to focus training and public outreach at the local level.
- Support county weed districts and other entities on local training programs on invasive aquatic plants as requested
- Support/encourage federal and state agencies to adopt mandatory inspect, clean, drain, and dry policies for field personnel.

Lead: Montana Department of Agriculture; Montana Fish, Wildlife and Parks; Montana State University Extension

Funding: $8,000

Time frame: on-going

Action Item II-4

Implement an education and outreach campaign for pet, pond, nursery and landscaping trades.

- Utilize existing habitat attitude materials for the pet trade.

- Develop messaging to be used at nurseries.
- Provide presentations and materials to professional meetings, landscaping expos and the general public.
- Develop a list of alternative native plants for commonly used aquatic invasive species.
- Provide educational materials to teachers and students.

Expand general public outreach and education on hazards of aquarium dumping and other unintentional release of invasive aquatic plants (e.g. aqua-scapes)

Lead: Montana Department of Agriculture

Funding: $25,000 (Invasive Species Account, nursery, weeds)

Time frame: January to September 2011

Action Item II-5

Inform the public on aquatic plant management techniques.

- Develop a research compendium on effects of management techniques on the aquatic environment and fisheries resources.
- Hold public listening sessions to receive public input on management options.

Lead: Montana Department of Agriculture Invasive Aquatic Plant Specialist

Funding: $5,000

Time frame: 2011

III. PREVENTION

Movement of contaminated trailers, boats, and other watercraft has been identified as a major factor in the introduction of invasive aquatic plants to non-infested water bodies. Dumping of aquariums and the accidental release of aquatic plants from aquascapes is the other main pathway of introduction. Prevention is the most practical and cost-effective weed management method, and is critical to the success of this plan.

Expected Result

Introduction and establishment of invasive aquatic plants into non-infested water bodies in Montana is prevented.

Action Item III-1

Expand inter- and intra-state mandatory watercraft inspection stations.

- Review existing watercraft inspection sites and expand number of inspection stations.
- Review inspection procedures and develop a consistent protocol so that states can expedite boat inspections, increasing efficiency, effectiveness and building public trust.

- Utilize cooperative agreements as necessary to delegate mandatory authority in order to supplement the efforts of FWP and MDA.

Lead: Montana Fish, Wildlife and Parks; Montana Department of Agriculture

Funding: $540,000/year (Cost is based on 12 stations at $45,000/station): this only allows for stations at one special management area and highways that are major points of entry into the state.

Time frame: Annually from May through mid-September

Action Item III-2

Identify high-risk water bodies for invasive aquatic plants in Montana.

- Identify lakes with no or minimal (<20 ft) annual drawdown (high risk for submersed aquatic plants other than flowering rush).
- Correlate FWP ANS high-risk monitoring sites with risk factors associated with invasive aquatic plants (e.g., presence in nearby water bodies, flow rate, substrate, water clarity, etc) and develop county-based maps on high-risk water bodies.
- Correlate travel flow patterns to predict likely transportation corridors serving as vectors (e.g. the Fort Peck-Canyon Ferry – Flathead Lake triangle).
- Provide maps to county weed districts and other stakeholders.

Lead: Montana Department of Agriculture; Montana Fish, Wildlife and Parks

Funding: (within existing FWP, MDA IS budget)

Time frame: March 2011

Action Item III-3

Implement site-specific prevention strategies to protect invasive aquatic plant-free water bodies from invasion (Appendix E).

- Design campaigns and strategies at the county or watershed level to protect water bodies.
- Post signs at infested water bodies (Appendix F).
- Consider installing invasive species disposal stations at fishing access site on infested water bodies (would require daily maintenance).

Lead: Montana Department of Agriculture; Montana Fish Wildlife and Parks; county weed district

Funding: $5000/yr

Time frame: 2011

Action Item III-4

Inspect nursery and pet stores for aquatic invasive plants and research online retailers.

- Train nursery inspectors on aquatic plant identification.
- Target nurseries with high volumes of aquatic plant sales for inspections.

- Inform and assist pet stores with licensing, and perform periodic inspections on stores selling aquatic plants.
- Research online retailers and provide them with information on what plants are illegal to sell to Montana.

Lead: Montana Department of Agriculture

Funding: within current program budgets

Time frame: 2011 and beyond

IV. Early Detection and Rapid Response (New infestations <100 Acres)

Early detection of newly invading aquatic plants and implementing rapid control measures is critical to protect non-infested water bodies. Effective early detection and rapid response (EDRR) will prevent widespread establishment of invasive aquatic plants.

Expected Result

Inspections/surveys of water bodies for invasive aquatic plants will be expanded and effective strategies to control and/or eradicate new infestations will be implemented. Effective EDRR will prevent widespread establishment of invasive aquatic plants.

Action Item IV-1

Design and implement county/watershed-based surveys of water bodies in Montana

- Finalize the invasive aquatic plant survey protocol (Appendix C).
- Coordinate state, county and stakeholder surveys/inspections to minimize duplication of efforts.
- Document invasive aquatic plant-free waterbodies and maintain records at state level.

Lead: Montana Department of Agriculture; Montana Fish Wildlife and Parks; county weed district

Funding: $40,000/yr (CAPS program, DNRC, MDA)

Time frame: Annually as season/plant growth stage permits (e.g. July through September)

Action Item IV-2

Ensure new species are identified

- Compile a "watch" list of potential new invasive aquatic plants and those currently infesting Montana (include aquatic plants on weed lists in adjoining states and provinces).
- Post list of invasive aquatic plants on MDA, FWP, Montana Weed Control Association, and other appropriate web sites (e.g. conservation district, watershed groups, etc.).

Lead: Montana Department of Agriculture; Technical Advisory Committee

Funding: within existing budgets

Time frame: annually review and update list

Action Item IV-3

Ensure accurate and timely reporting of new invasions

- Work with county weed districts and other stakeholders to implement EDDMaps for reporting invasive aquatic plant infestations.
- Confirm species within one week of a reported sighting.

Lead: Montana Department of Agriculture; county weed districts

Funding: within existing budgets

Time frame: on-going

Action Item IV-4

Ensure rapid response to new infestations of invasive aquatic plants.

- Follow rapid response protocol and decision tree (Appendix C).
- Develop and update a list of contacts within agencies listed in the rapid response protocol and update annually (MDA responsibility).
- Determine feasibility of special management area designation around infested water bodies.
- Develop memorandum of understanding with agencies for early detection and response to new invasions.
- Develop a strike team that has expertise in protocol, procedures, planning and treatment of new infestations of invasive aquatic plants. *Invasive species coordinator will serve as lead for implementing rapid response.*
- Implement control effort using best available technology and practices.

Lead: County weed districts; Montana Department of Agriculture

Funding: Cost is dependent on the number of new infestations, acreage infested, site conditions, species, and management method selected: budget $250,000 annually

Time frame: Strike team will be identified by May 2011

Action Item IV-5

Ensure proper action is taken for containment and control.

- Compile an on-call list of experts for the following:
  - Species identification
  - Management
  - Rapid response expertise
- Consult Technical Advisory Committee for input and review of management options.
- Reference control methods and decision trees for invasive aquatic plants listed in Appendix G.

Lead: Montana Department of Agriculture; county weed districts

Funding: within existing budgets

Time frame: Compile list of on-call experts by May 2011; other action items as needed

Action Item IV-6

Identify and remove rapid response constraints

- Develop regional or watershed based Environmental Assessment(s) (EA) to expedite implementation of invasive aquatic plant control programs.
- Identify constraints that may obstruct implementation of prevention and monitoring programs, such as government policies, regulations, or conflicting mandates.
- Identify constraints that obstruct implementation of containment and control programs, such as insufficient research to guide management decisions based on species and/or site conditions.
- Facilitate permit process for physical removal of invasive aquatic plants on a project or regional scale by working with Department of Environmental Quality [318 permits], FWP [124 permits] Army Corp of Engineers [404 permits], and conservation districts [310 permits].
- Work closely with Department of Environmental Quality to facilitate MPDES PGP that would allow for rapid response to new invasions of aquatic plants.

Lead: Montana Department of Agriculture; Montana Fish, Wildlife and Parks; Department of Natural Resources and Conservation

Funding: EA cost unknown

Time frame: Environmental assessment should be initiated in spring 2011; other activities are on-going

V. Management (Established Infestations >100 Acres)

Strategies to manage established populations of invasive aquatic plants will be determined based on size of the infestation, merits of management techniques, and economic, environmental, and technical constraints.

Expected Result

Existing invasive aquatic plant populations in Montana are reduced by implementing science-based containment and control programs.

Action Item V-1

Contain existing infestations

- Establish special management areas around infested water bodies or quarantine the site to stop movement of invasive aquatic plants
- Develop containment and control strategies based on best management practices.
- Coordinate containment and control strategies between individuals or agencies responsible for management of the infestation (e.g. Bureau of Reclamation, U.S. Army Corps of Engineers, DNRC, private).

Lead: Montana Department of Agriculture; Technical Advisory Committee; county weed district serve in supporting role

Funding: $10,000

Time frame: as needed

Action Item V-2

Reduce existing infestations

- Implement science-based control programs and evaluate efficacy of management methods.
- Implement adaptive management based on evaluation results.

Lead: Montana Department of Agriculture, Technical Advisory Committee; county weed district or local task force serve in supporting role

Funding: $300,000 annually based on level of infestations as of this writing (does not include inspection stations)

Time frame: on going

Action Item V-3

Support research to identify and implement best management practices.

- Expand knowledge on techniques to manage established infestations based on site conditions, use, management objectives and infestation characteristics.

Lead: Universities; Montana Department of Agriculture; Fish Wildlife and Parks; other stakeholders

Funding: see research budget VII-1

Time frame: on-going

Action Item V-4

Identify and secure funding for long-term management of existing infestations.

Lead: Department of Natural Resources and Conservation; Montana Department of Agriculture; Healthy Habitat Coalition

Funding: estimated $550,000/yr for control of new infestations and those that are currently well established- amount shown in IV4 and V2

Time frame: on-going

VI. Restoration and Reclamation

Expected Result

Susceptibility of aquatic environments to invasion by non-native plants is reduced.

Action Item VI-1

Conduct literature review and summarize published scientific information to:

- Determine potential for increasing native aquatic plant communities' resistance to invasion by non-native aquatic plants.
- Determine the affect of reservoir drawdown timing and duration on native and invasive aquatic plant communities.
- Determine the impact of invasive aquatic plants (e.g., flowering rush) colonizing previously open water habitat on native fauna that have evolved with oligotrophic[7] systems.

Lead: Montana Department of Agriculture; Universities; DNRC restoration program

Funding: $30,000

Time frame: initiate in 2011

VII. Research and New Technology

Expected Result

Research projects that strive to protect non-infested water bodies and the function of aquatic environments are supported and long-term partnerships among researchers and managers are developed.

Action Item VII-1

Identify research needs:

- Support research to identify potential solutions to constraints identified in IV-6 and data gaps identified in VI-1.

Lead: Montana State University, Technical Advisory Committee, Montana Department of Agriculture

Funding: budget $150,000/yr

Time frame: Fall 2011

Action Item VII-2

Facilitate collaboration among research scientists and county weed districts to advance knowledge, refine research, and guide long-term management.

Lead: Universities, Technical Advisory Committee, county weed districts, Montana Weed Control Association

Funding: within existing budgets

Time frame: on-going

[7] Oligotrophic systems are those that have limited ability to support native plants based on low nutrient levels or other factors.

VIII. Adaptive Management

Adaptive management allows the state to learn from past experiences, improve effectiveness, and reduce impacts. A cornerstone of adaptive management is assessing the efficacy of management actions over time. This requires analyzing information gained through monitoring, including benefit/cost analysis compared to other alternatives, comparison with non-treated areas, and projected costs of no action. Information gained from monitoring program components will be used to improve future invasive aquatic plant management efforts in Montana.

Expected Result

The effectiveness of program components are measured and analyzed, and management methods are modified, thereby increasing acceptance and use of best available methods.

Action Item VIII-1

Annually review implementation and effectiveness of action items to meet expected results.

- Develop monitoring protocols for evaluating treatment effectiveness and support protocols with sampling and data collection.
- Review existing procedures and protocols against new information, MOUs, and response actions.
- Review committee will consist of Montana Noxious Weed Summit Advisory Committee, Technical Advisory Committee, Montana Department of Agriculture and Montana Fish, Wildlife and Parks

Lead: Montana Department of Agriculture

Funding: within existing budgets

Time frame: annually

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Chapter 5. Appendices

Appendix A. Cooperative Agreement Between FWP and MDA (Aquatic Invasive Species Act)

Appendix B. Laws and Regulations

Appendix C. DRAFT Rapid Response Protocol

Appendix D. Aquatic Plant Survey Methods

Appendix E. Prevention Measures

Appendix F. Sample Wording for Temporary Site Closure

Appendix G. Management Decision Tree (broadleaf invasive aquatic plants e.g. Eurasian watermilfoil).

Appendix H: Comparison of Physical Treatment Options for Invasive Aquatic Plant Management (Mattson et al. 2004)

Appendix I: Herbicide guidelines for invasive aquatic weed management in Montana based on herbicides approved in the state

Appendix J: Cost of Management options

Appendix K. Technical Background for Established Aquatic Noxious Weeds in Montana and Surrounding States and Provinces

APPENDIX A. COOPERATIVE AGREEMENT BETWEEN FWP AND MDA (AQUATIC INVASIVE SPECIES ACT)

SUMMARY COOPERATIVE AGREEMENT

The entire cooperative agreement can be obtained by contacting Montana Department of Agriculture (MDA) or Fish, Wildlife and Parks (FWP)

Montana Aquatic Invasive Species (AIS) Act: Section 5: "....In order to implement, administer, and accomplish the purposes of [sections 1 through 14], the departments, collectively or individually, shall enter into a cooperative agreement with each other or may enter into an agreement with any person with the appropriate expertise and administrative capacity to perform the obligations of the agreement."

Act directs MDA to take the lead in coordinating development of cooperative agreements with other agencies to clarify their respective responsibilities

To aid in collaboration of aquatic invasive species issues, the department of FWP and MDA will:

- Share information related to travel, public outreach, and planned aquatic invasive species activities, both before and after the activity to provide awareness by both departments (see attachment)
- Implement specific responsibilities identified under the Act, e.g., aquatic invasive species list, Montana AIS Strategic Plan, check stations, and public education and awareness;
- Whenever possible, use uniform concepts and messaging;
- Share data and information regarding all aquatic invasive species;
- Provide each other with quarterly summary information on aquatic invasive species issues so that each agency is fully aware and adequately informed. Exchange of information should occur more frequently when issues arise;
- Collaborate on preparation and presentation of a joint report to the Montana Legislature on FY10 and 11 accomplishments as a result of the Montana AIS Act;
- Collaborate on the designation of invasive species management areas; and
- Collaborate on requests for a declaration of an aquatic invasive species emergency from the Governor.

In addition, MDA will:

- Provide statewide, regional and national coordination for Montana on aquatic invasive plants, insects, and plant pests. Coordination will be through the designated MDA invasive species coordinator in collaboration with FWP;
- Coordinate primarily with the FWP Aquatic Nuisance Species Coordinator and secondarily with the Fish Hatchery Section Supervisor to provide updated information on invasive species issues so that FWP is aware of and informed about important invasive species issues as they arise;

- Sponsor meetings to bring together departments, agencies, organizations and other interested parties to facilitate communication, public input, and information exchange;
- Prepare Invasive Species, Noxious Weed and Pest Management Plans and provide executive summaries for inclusion in a statewide AIS Strategic Plan;
- Conduct education and awareness outreach on invasive species to groups traditionally associated with MDA, including: irrigators, Farm Bureau, and other agriculture-based organizations;
- Provide funding, authorized by the Montana Legislature or deposited in the "Invasive Species Account" established by the Legislature for aquatic invasive species work, to FWP or other groups/organizations to supplement ongoing aquatic invasive species work;
- Conduct invasive species check stations at borders and along major transportation corridors to educate and inspect boaters, recreational users and the general public on invasive species;
- Expand the number of invasive species check stations as funding becomes available;
- Continue to implement MDA actions under the Montana ANS Management Plan; and
- Coordinate the development of a joint legislative aquatic invasive species report addressing the FY10 and 11 accomplishments of the AIS Act.

In addition, FWP will:

- Provide statewide, regional and national coordination for Montana on aquatic nuisance species (ANS) by the FWP aquatic nuisance species coordinator in collaboration with MDA; Coordinate primarily with the MDA Invasive Species Coordinator and secondarily with the Noxious Weed Coordinator to provide updated information on ANS issues so that MDA is aware of and informed about important ANS issues as they arise;
- Provide an executive summary for the FWP ANS program to MDA for inclusion in a statewide AIS Strategic Plan; *MDA-FWP AIS Cooperative Agreement Page 5*
- Expand the statewide early detection and surveillance monitoring program for quagga/zebra mussels and other aquatic invasive species under the jurisdiction of FWP as funding becomes available;
- Continue to operate the regional veliger mussel lab for early detection;
- Conduct boat inspections at high profile waters to educate anglers/boaters on aquatic invasive species;
- Expand the number of boat inspection sites as funding becomes available;
- Continue to implement FWP actions under the Montana ANS Management Plan. The FWP ANS Coordinator will lead the coordination and preparation of plan updates and annual progress reports. Annual progress reports will be prepared, disseminated and made available to the general public and to local, state and federal decision makers; and
- Revise and update the ANS Plan as needed in collaboration with MDA, other state, federal, tribal and local agencies and interested parties.

APPENDIX B. LAWS AND REGULATIONS

MONTANA DEPARTMENT OF AGRICULTURE (MDA)

Montana Weed Control Act

The Montana Weed Control Act (80-7-701 et. seq., MCA) gives the Montana Department of Agriculture authority to provide technical assistance and coordination/ services to local governments, agricultural producers, and the general public on management and control of noxious plants. This assistance and service may include local information on infested acreages and an assessment of the economic and environmental impacts on the state and its citizens as a result of these conditions. In addition, MDA must make information available on proper use of herbicides and recommend where certain management tools should be utilized in order to avoid adverse economic or environmental impacts.

The Weed Control Act also authorizes MDA to seek federal funds under 43 U.S.C. 1242 to implement management of noxious plants on federal lands in cooperation with any federal agency and the local government body responsible for noxious plant management.

Montana Quarantine and Pest Management Act

Montana Department of Agriculture has authority through the Montana Quarantine and Pest Management Act (80-7-401 et seq., MCA) to adopt rules concerning intrastate and interstate quarantine, and develop procedures to investigate and enforce quarantines to prevent introduction or spread of noxious weeds and other exotic plants into Montana. In addition, the Department may adopt rules regarding procedures for introduction of biological control agents into the state.

Montana Pesticides Act

The Montana Department of Agriculture administers the Montana Pesticides Act (80-8- 801 et seq., MCA), which requires the registration of all pesticides manufactured, formulated, distributed, sold, or transported in the state. Commercial and government applicators must be licensed to apply pesticides and farm applicators must obtain special use permits for restricted use pesticides. In addition, pilots and aircraft involved with aerial application must be registered by the Montana Department of Commerce. The State of Montana has primacy for enforcement of FIFRA under the Montana Pesticides Act.

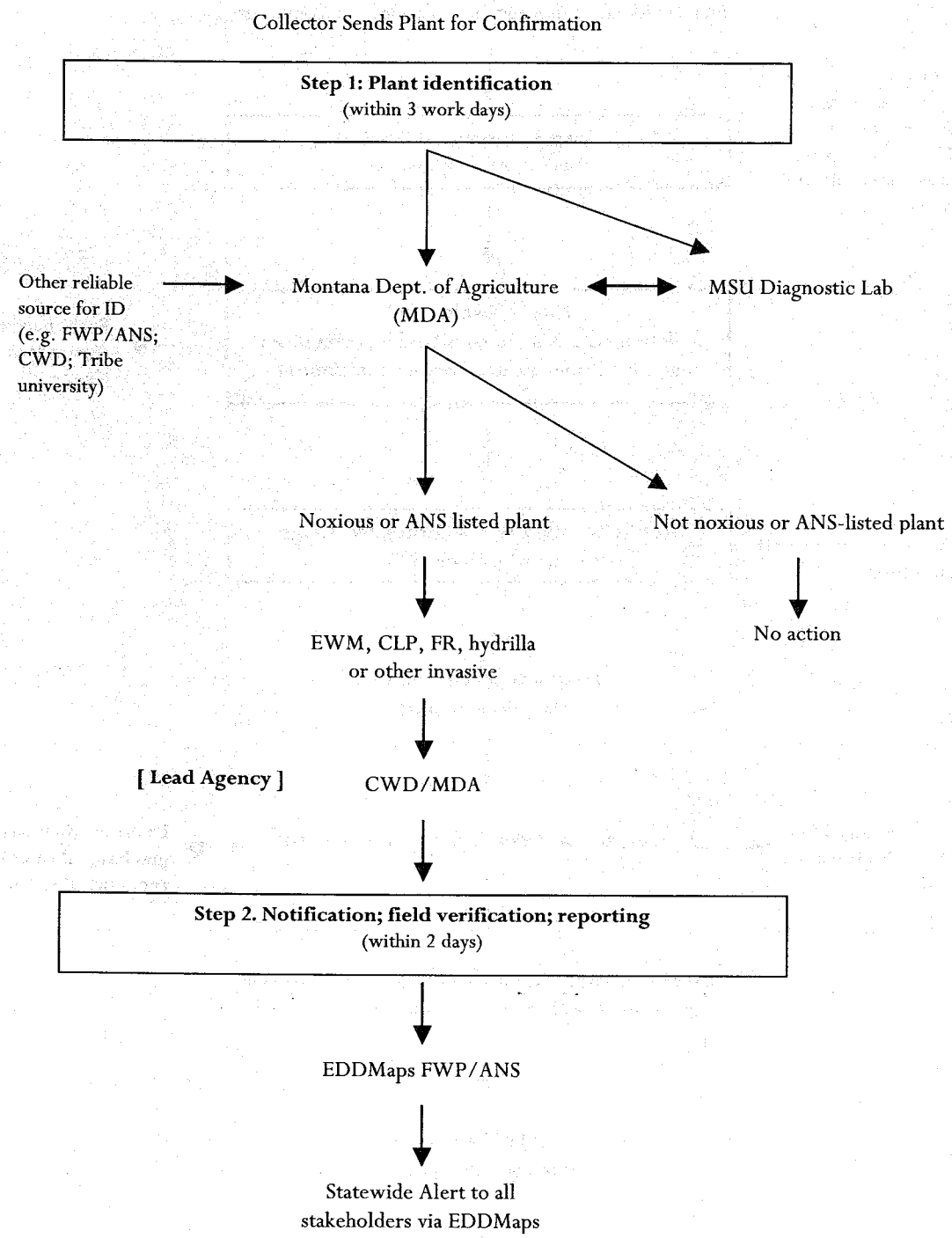
MONTANA DEPARTMENT OF ENVIRONMENTAL QUALITY (DEQ)

Montana Water Quality Act

The DEQ is responsible for administration of the Montana Water Quality Act (75-5-101 et seq., MCA). This law provides a framework for classification of surface and groundwater, establishes surface and groundwater quality standards, and provides for a permit program to control discharge of pollutants into state waters. State waters are required to be free of discharges that create toxic concentrations harmful to human, animal, plant, and aquatic life. The purpose of the law is to provide adequate remedies to protect state waters from degradation and prevent unreasonable depletion and degradation of natural resources.

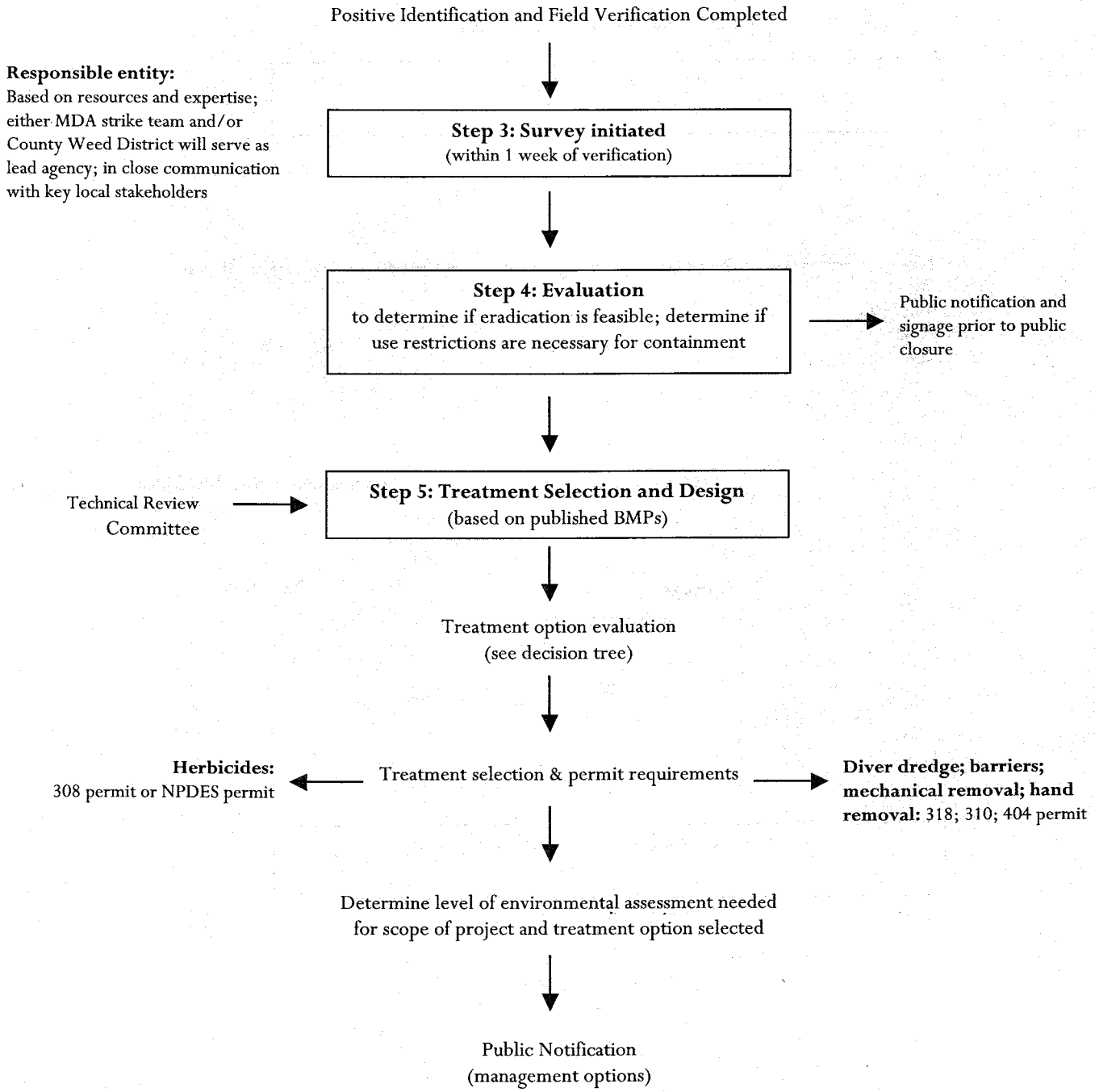
APPENDIX C. DRAFT RAPID RESPONSE PROTOCOL

FLOW CHART FOR RAPID RESPONSE (IDENTIFICATION AND FIELD CONFIRMATION)[8]

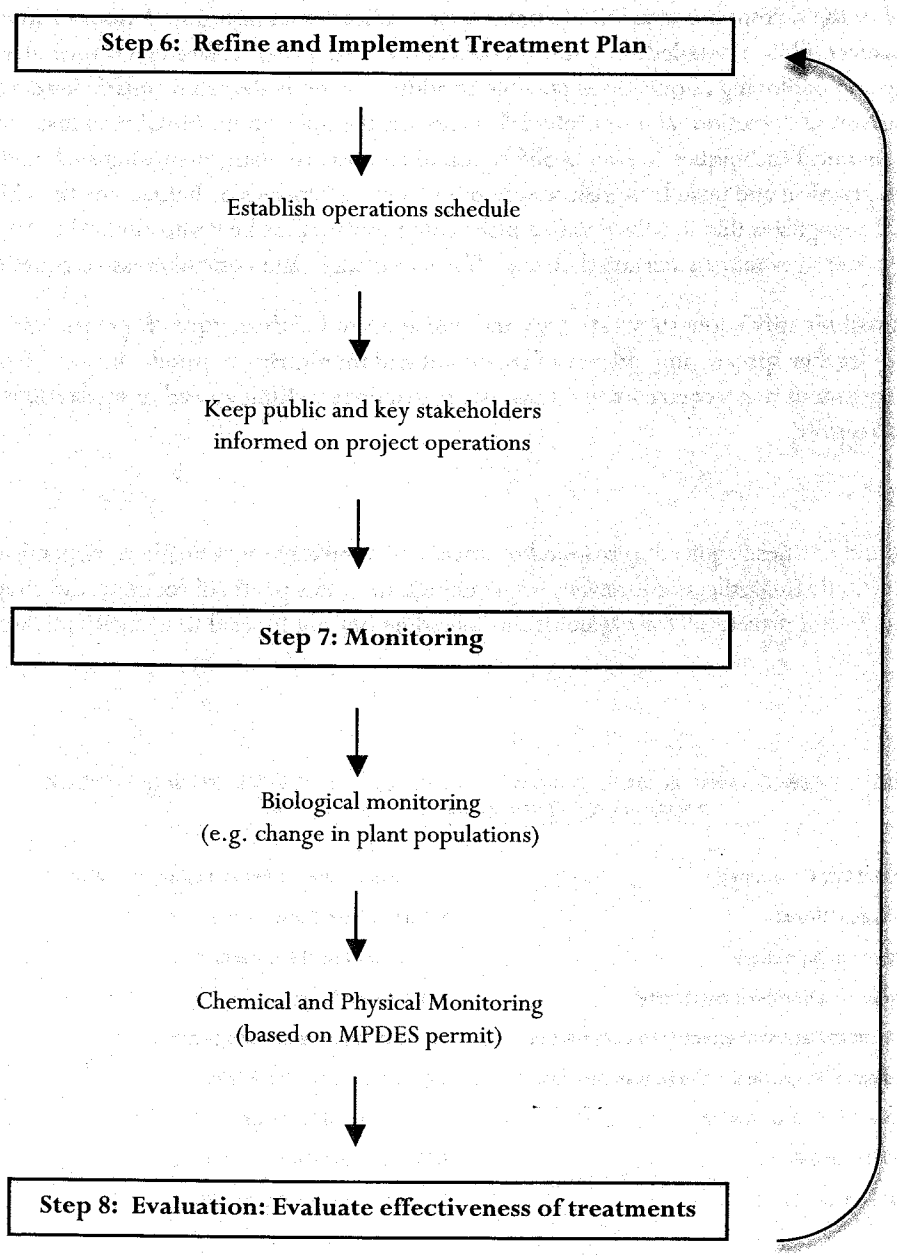


[8] Abbreviations: Aquatic nuisance species (ANS); County Weed District (CWD); Fish Wildlife and Parks (FWP); Fish Wildlife and Parks (FWP); Eurasian watermilfoil (EWM); curlyleaf pondweed (CLP); flowering rush (FR).

FLOW CHART FOR RAPID RESPONSE: RESPONSIBLE AGENCY CWD/MDA (SURVEY, EVALUATION, TREATMENT SELECTION AND DESIGN, PUBLIC NOTIFICATION)



FLOW CHART FOR RAPID RESPONSE (REFINE TREATMENT PLAN, IMPLEMENTATION, MONITORING, EVALUATION)



SCOPE AND PURPOSE

The purpose of this protocol is to coordinate a rapid and effective interagency response to verify, delineate, contain, and when feasible, eradicate invasive aquatic plants. This protocol assumes that a detected population has not dispersed widely until further analysis reveals otherwise. This protocol focuses on actions that follow a reported introduction.

The primary goal of rapid response is to initiate immediate eradication of new populations or interim containment measures while a detailed, long-term eradication or suppression strategy is formulated. This means mobilizing and deploying as quickly as possible to address a newly detected aquatic invasive plant within the first season of detection, and to preferably eradicate the infestation. Initial response requires physical and/or chemical techniques to stop proliferation of an invasive plant, providing such techniques or treatments are practical and pose little risk to rare or endangered species or human health. This rapid response protocol recognizes that localized native plant communities may be compromised in the short term, or surface water uses may be curtailed during efforts to contain and control invasive aquatic plants.

Treatment plans will identify a long-term strategy and will account for the nature of species, site conditions, risk of further spread, and efficacy of treatment and monitoring methods. In some cases, a rapid response assessment may require longer-term use restrictions to limit spread of infestations when eradication is not feasible.

RESPONSIBILITIES

Specific agencies and entities required to respond to discovery of invasive aquatic plants depends on where infestations are located. Regardless of location, implementation of this protocol relies on the cooperation of a variety of public and private sector organizations including but not limited to agencies included in Table 1.

TABLE 1: AGENCIES AND ORGANIZATIONS WITH INVASIVE AQUATIC PLANT MANAGEMENT OR COORDINATION RESPONSIBILITIES IN MONTANA

County and City Governments	Private utility companies and other landholders
County Weed Districts	Soil and Water Conservation Districts
Department of Agriculture	U.S. Army Corp of Engineers
Department of Environmental Quality	USDA Forest Service
Department of Natural Resources and Conservation	USDI Bureau of Land Management
Department of Public Health and Human Services	USDI Bureau of Indian Affairs
Department of Transportation	USDI Bureau of Reclamation
Fish, Wildlife and Parks	USDI Fish and Wildlife Service
National Park Service	University System (UM and MSU)

The Montana Department of Agriculture (MDA) is responsible for:

- Development, annual review, and maintenance of this protocol

- Posting current protocol on the MDA website
- Collaborating with the local management task force[9] and other agencies, organizations, and individuals to ensure all participants are aware of their roles and the procedures in this protocol, as well as changes to the protocol when such modifications occur.

RESPONSE PROTOCOL FOR INVASIVE AQUATIC PLANTS

- Step 1: Species identification and confirmation of infestation
- Step 2: Notification of responsible parties and reporting
- Step 3: Survey and containment of infestations
- Step 4: Evaluation and use restrictions
- Step 5: Treatment selection and design
- Step 6: Refine and implement treatment plan
- Step 7: Monitoring (biological and chemical)
- Step 8: Evaluate effectiveness of treatment methods

Step 1: Species Identification and Confirmation of Infestation

Private, county, state and federal entities that find and/or suspect an infestation of an invasive aquatic plant should take the following action to confirm identification of the plant:

- Collect a sample of the plant and place it in a plastic zip-lock bag with damp paper towels, and put the bag in a cooler or other container to protect from damage (heat, cold, physical damage).
- Complete the plant identification form (located at end of this document) and send the form and the sample to MDA and Montana State University diagnostic lab for analysis. Samples should be sent in damp paper towels in a zip-lock bag. The bag should be placed in a padded box so the sample can't be crushed, and sent next day delivery (Monday through Thursday). Shipping addresses are shown on the plant identification form.
- Following positive confirmation of an invasive aquatic plant, Montana State University diagnostic lab will immediately contact Montana Department of Agriculture.
- The Montana Department of Agriculture will contact the collector immediately (within 3 days) following positive confirmation. If DNA analysis is required, confirmation of the species will be delayed until DNA evidence is obtained. *Hybrids of any invasive species will be treated the same as the true invasive species in a rapid response program.*

Private individuals can collect plant samples as described above and deliver it to the county weed district (CWD), Cooperative Extension Service, Conservation District, Fish, Wildlife and Parks (FWP), MDA or other government entity which will send to MDA and MSU diagnostic lab for identification.

ON-SITE CONFIRMATION—Following positive confirmation, on-site confirmation of the invasive plant will be made by MDA or FWP.

Step 2: Notification and Reporting

MDA will record the location of the plant and immediately notify the FWP ANS program coordinator, universities (UM and MSU), county weed districts, county extension agents, conservation districts, county commissioners, and other stakeholders listed in Table 1 (signed agreement). EDDMaps will

[9] Local task force may be formed that includes stakeholders in managing invasive aquatic plant infestations. They may include agencies (county, state, and federal), private corporations, individuals, and other directly involved with overseeing the management project, including public outreach, quarantine, containment and control.

provide next-day weed alerts throughout the Northwest once the species is confirmed. If the infestation is located in a water body that is shared by a downstream adjoining state, state agricultural departments and university weed science departments in the given state will be contacted. Following notification of these individuals, MDA will contact the news media to notify the public and report the proposed response. Notification will be done within one to two weeks.

Montana Department of Agriculture will work closely with FWP ANS program, EDDMaps, and county weed districts to track invasive aquatic plants.

REPORTING—Management status (plan, inventory, control, etc. of new infestations) will be reported to organizations and agencies involved with oversight and management of the infestations within the watershed as new information becomes available. Montana Department of Agriculture will work with FWP ANS coordinator, universities, and local officials to record and file relevant information including:

- Specific location (GPS) of invasive plant within water body
- Size of infestation
- Date and time of collection
- Contact information for person that reported plant
- Suspected method of introduction
- Site characteristics
- Spread potential and spread vectors
- Voucher specimen will be collected and housed in herbarium

Step 3: Survey and containment of infestations

This step will be completed within one month of confirmation of an infestation unless a longer process is required for permitting, public notification, or determining the size of the infestation. The Montana Department of Agriculture Invasive Species Coordinator will evaluate the potential of the invasion to spread and the likelihood of eradication based on species characteristics, site conditions, and size of infestation.

SURVEY AND CONTAINMENT—The MDA will work with local stakeholders to survey the distribution and abundance of the population (see survey methods in Appendix D). An initial survey will delineate the extent of the infestation in order to identify impacted water bodies. A map of infested sites will be developed using computerized geographical positioning system (GPS) or other map program. Infestations will be marked with stakes or buoys. When feasible, barrier curtains or other containment devices should be installed to isolate the infestation from non-infested areas. Temporary closures will be put into action and signage will be posted at public access points at or near the infestation as needed to stop movement from infested water bodies.

Step 4: Evaluation and restrictions to use

The MDA, CWD, and /or aquatic plant experts will work with local stakeholders (including land owner or manager) to compile and evaluate preliminary information to determine the threat posed by the infestation and potential for eradication. This evaluation will determine if rapid response is needed and immediate surface use restrictions are required. In addition to plant species, type, extent, and location, the MDA and stakeholders will consider the following:

- Depth, flow, water quality, configuration of water body and watershed;
- People, flora, and fauna directly/indirectly affected;

- Rare or endangered plants or animals;
- Available treatment options.

SURFACE USE RESTRICTIONS—Upon confirmation of an infestation, surface use restrictions will be considered to ensure public safety and limit spread of an infestation. The Montana Department of Agriculture or the county weed district will consult with representatives from FWP, local governments, municipalities, and other local stakeholders as necessary, especially if limitations on boat launches or other public facilities are involved.

Boating (use of watercraft) and movement of boats from infested lakes should be controlled through use restrictions. Other activities such as swimming, water removal, or sea plane landings might also pose a significant risk to preventing spread to new sites.

Montana Department of Agriculture in consultation with county weed district and FWP may designate and administer an invasive species management area to prevent and control the infestation or minimize spread of an invasive aquatic plant (SB343 Sec 8). Montana Department of Agriculture has the authority to arrange for prevention, treatment, control, and eradication of the designated species without the consent of the land manager or landowner (SB343 Sec 9). Once the invasive species management area is formed, MDA shall establish a check station(s) to prevent the introduction, importation, infestation, and spread of the invasive aquatic plant species for which the designation was issued (SB343 Sec 11).

Step 5: Treatment Selection and Design

Montana Department of Agriculture in consultation with the technical advisory committee, will work with the landowner/manager and determine the most effective management strategy based on the highest potential to eradicate target plants and least potential to impair human or ecological health or other natural or cultural values. It is likely, given the need to respond quickly, that the complete extent of the infestation will not be fully known by the time treatments for individual sites are selected. Treatment of known infestations may occur while the delineation surveys are in progress. Treatments should be selected within three weeks from receiving the report about the infestation.

TREATMENT OPTION EVALUATION—The Montana Department of Agriculture will work with a technical advisory committee, and land owner/manager to identify management options and evaluate the efficacy and potential impacts of each option based on the following factors:

- Species type
- Size of population and number of colonies
- Extent and location of infestation
- Density and diversity of native vegetation
- Substrate type and bottom obstructions
- Water clarity, depth, and movement
- Presence of rare or endangered species and communities
- Presence of public facilities
- Water and land uses
- Boating traffic densities and patterns
- Public perceptions
- Data on efficacy of proposed control option at other similar locations

TREATMENT SELECTION AND DESIGN—Montana Department of Agriculture, CWD, and Technical Advisory Committee and landowner/manager will develop a preliminary treatment plan prescribing:

- Methods and expected outcome
- Costs and sources of materials, labor, equipment, and other expenses (Appendix J)
- Timetable and assignment of responsibility for each action
- Permitting requirements, if appropriate
- Project management and coordination
- Biomass tabulation and disposal methods
- Pre-treatment data collection
- Public information program
- Follow-up monitoring and evaluation

PERMITTING REQUIREMENTS[10]—Montana Department of Agriculture or county weed district will obtain permits for various treatment methods described below. Permits will need to be obtained as soon as treatments are selected for a project area since there are timelines for review and authorization from respective agencies.

- ***Bottom barriers, exclusion barriers (in water column), diver-operated suction, mechanical harvesting equipment, and manual removal techniques that cause turbidity*** will require a 318 Authorization from Department of Environmental Quality (DEQ). There is currently a review fee by DEQ. However, FWP fisheries biologist can issue a 318 authorization on behalf of DEQ without the fee (based on an MOU between FWP and DEQ). The fisheries biologist and applicant sign the authorization, and approval is at discretion of the biologist usually with "same day" approval. A 124 permit is also needed for government (county or state) directed projects. This permit is issued by FWP. If the project is privately directed then a 310 permit (rather than 124 permit) issued by the Conservation District may be required for diver-suction operations. A 404 permit from Army Corp of Engineers will also be required.
- ***Herbicide application for aquatic plant control.*** A 308 Authorization from DEQ is required for herbicide applications made directly to water encompassing **less than 64 acres in size annually**. There is a $250 review fee with a 30 to 60 days approval period. However, DEQ can issue approval within two weeks for emergencies (based on staff schedule). DEQ will complete a checklist Environmental Assessment as part of approval of 308 Authorization. Herbicide treatments directly to water that will be **greater than 64 acres annually** will require a Montana Pollutant Discharge Elimination System (MPDES) pesticide general permit. In accordance with federal requirements in the Clean Water Act, the Montana Department of Environmental Quality (DEQ) Water Protection Bureau is in the process of developing a general permit for application of pesticides (including herbicides for aquatic weed control) to state surface waters. The Montana DEQ has until April 9, 2011 to issue a final MPDES pesticide general permit (PGP) for pesticide applications. The Environmental Protection Agency has drafted a federal pesticide general permit, which will regulate application of pesticides to surface water in all Indian Reservations within the State of Montana. For all other surface waters of the state, Montana is required to develop a MPDES Pesticide General Permit that is as stringent as the federal Pesticide General Permit but will incorporate state-specific issues. One notable exception is that irrigation return water and irrigation storm water runoff is not a regulated activity under the Clean Water Act and will be exempt from this program. The DEQ is working closely with Montana Department of Agriculture and stakeholders to meet the April 9, 2011 deadline. Additional information is available at: http://deq.mt.gov/wqinfo/mpdes/default.mcpx.

[10] As of this writing, MDA is working with permitting agencies to expedite permitting process.

ENVIRONMENTAL ASSESSMENTS—Montana Department of Agriculture, CWD and Technical Advisory Committee will determine the scope of environmental analysis required prior to implementing management methods. A checklist EA may be used for small-scale projects to determine if more extensive environmental review is required.

PUBLIC NOTIFICATION—Montana Department of Agriculture/CWD in cooperation with local stakeholders will notify and involve the public as soon as possible (see Step 1) as to the extent practical prior to implementing either physical or chemical management methods.

- ***Physical methods*** (manual, driver-operated suction, bottom barriers, and/or mechanical harvesting): MDA/CWD will notify and or consult in developing the plan with land owner/manager, local task force, county extension agents and/or other state or federal agencies, and additional stakeholders as identified.
- ***Chemical methods***: MDA/CWD will notify and or consult in developing the plan with land owner/manager, local task force, county extension agents and/or other state or federal agencies, and additional stakeholders as identified. Herbicide treatments will meet MPDES permit requirements.

Step 6: Refine and Implement Treatment Plan

Technical aspects of a treatment plan will vary according to species involved, techniques used, and on-site factors. A treatment plan may include a single approach or a combination of techniques.

Prior to treating a water body, the CWD/MDA will work with land owner/manager and conduct the following activities:

- Secure access agreements that may be required for operations,
- Solicit and coordinate volunteers and/or consultants
- Provide maps, coordinates and other materials to contractors as needed to facilitate control
- Prepare staging site, materials, and equipment
- Arrange for biomass disposal site and procedures
- Establish safety and communication protocols
- Select water quality monitoring sites (if necessary)
- Establish an operations schedule
- Keep public informed and involved as appropriate
- Provide oversight and guidance during the treatment program

Plant material removed during the control program will be bagged or otherwise contained and removed from the site. Harvested plants will be placed in a compost facility, in a site away from moisture where they can reenter the water body, or if these options are not available, in a waste disposal or incineration facility.

County weed district and other stakeholders will give priority to completing control efforts as soon as possible so that restrictions may be lifted and normal activities may resume.

Step 7: Monitoring

Monitoring is important for effective control and to increase the chances of eradication success. Monitoring will be tailored for the target species, conditions, and control methods used. Post-treatment results will be compared with pre-treatment data for up to 5 years following the first year of infestation-free status. On high-risk sites for invasion, annual monitoring may be continued indefinitely.

BIOLOGICAL MONITORING—Montana Department of Agriculture will work with CWD to provide guidance and possible funding for survey of target and non-target aquatic plant populations. Surveys will be conducted at time intervals appropriate for each species in zone of influence and downstream sites. Accepted survey methods include a variation on the point-intercept method (Appendix D). This can be augmented with visual observations at selected fixed sampling points.

CHEMICAL AND PHYSICAL MONITORING—*Note: this section will be updated with MPDES permit required in 2011.* Pre-and post-treatment data on water chemistry and physical parameters will be obtained at intervals appropriate for circumstances. When herbicides are to be applied, staff will use appropriate and accepted monitoring methods and practices to sample for chemical residues in water, or biota as stipulated in a general permit for each herbicide. Herbicide monitoring plan will likely include testing for concentrations immediately after treatment and at appropriate intervals, depending upon species until non-detect level is reached. If a lake has an outlet, downstream concentrations will be measured to determine if detectable levels are recorded. In selecting testing locations, consideration will be given to including locations of highest likely effect – such as aquatic habitats where sensitive plant or fish populations occur.

Step 8: Evaluation

Montana Department of Agriculture/CWD will work with the technical advisory committee to review biological, chemical, and physical data in evaluating effectiveness of the treatment. This will include the assessment of additional treatments and other techniques applied in the same season or in subsequent years until management goals are achieved. Montana Department of Agriculture in cooperation with partners will report results to stakeholders.

PLANT IDENTIFICATION FORM

Schutter Diagnostic Lab
119 Plant BioScience Facility
Montana State University
Bozeman, MT 59717

Montana Department of Agriculture
Weed Program
6th and Roberts
Helena, MT 59620

Date: _____ **(MM/DD/YY)**

Client Name: _____ **Email:** _____
Address: _____ **Phone:** _____

Accompanying this form is a plant sample to be identified. Please answer all items before submitting the plant sample.

1. Sample collected by: _____ **Phone:** _____
Address: _____

2. Sample was collected in this Montana County: _____

3. Sample was collected in this habitat (circle proper item or specify below):

STREAM/RIVER | POND (<10 ACRES) | AQUASCAPE (ORNAMENTAL POND) | LAKE (>10 ACRES) | OTHER (SPECIFY BELOW)

DESCRIBE: _____

4. Sample is this kind of plant (circle proper item):

LANDSCAPE | WILD PLANT | OTHER

5. Sample is from this form of plant: (circle proper item):

MOSS | BROADLEAF PLANT | GRASS PLANT | DON'T KNOW

6. Prevalence: (circle proper item):

ABUNDANT | SEVERAL | SCATTERED FEW | OR JUST ONE

7. Other plant information: _____

8. Email identification information: yes no: email address: _____

COUNTY _____ **Agent** _____

COMMENTS (for use by MDA or Herbarium) _____

_____

APPENDIX D. AQUATIC PLANT SURVEY METHODS

Detailed information regarding point intercept and line intercept survey methods are reported in Madsen 1999[11]. Note: Aquatic plant surveys should be conducted annually when aquatic plants are most visible (e.g. late July through mid-September for Eurasian watermilfoil, and June, July or late September for curly leaf pondweed)

SURVEY PROTOCOL (RESERVOIRS):

Survey aquatic vegetative community

- Review bathymetric maps[12] of survey area for probable invasive aquatic vegetation locations.
- Pre-select points on a GIS generated map and conduct a point intercept survey to quantify distribution and frequency of aquatic vegetation (Madsen 1999).
- Within a given point, use a combination of a sampling rake, or divers to identify species and provide percent cover estimation for each species.
- Generate maps of dense non-native aquatic plant beds from a grid of point observations
- Record depth, sediment type (mud, sand, rock, or organic) at each sample site.
- Collect secchi depth[13] readings at three to six locations
- If working with Eurasian watermilfoil, retain a random sub-sample of the plant for genetic identification testing and provide digital photographs of these samples.
- Collect one herbarium voucher of each aquatic plant species.

Littoral Survey (along lake shoreline)

- Survey conducted from a boat using rake throws and/or underwater viewers, by snorkeling or SCUBA divers.
- Record GPS coordinates of invasive emergent shoreline plants and submersed aquatic invasive vegetation (e.g. curly-leaf pondweed and flowering rush).
- Survey of high-risk point sites (boat docks and fishing access sites) can be conducted from shore. Survey 100 meters (300 ft) upstream and downstream from initial access point using rake throws and/or underwater viewers and record GPS coordinates of invasive aquatic vegetation.

Survey (streams and rivers):

- High risk areas include sites where stream gradient slows (areas of deposition) and back-water sloughs and channels
- Survey conducted from shore or small watercraft with rake throws and/or underwater viewers, by snorkeling or SCUBA divers.

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[11] Madsen JD. 1999. Point intercept and line intercept methods for aquatic plant management. US Army Engineer Waterways Experiment Station Aquatic Plant Control Research Program. Technical Note CC-02, Vicksburg, Mississippi.

[12] Bathymetric maps show water depth based on geographical coordinates.

[13] Secchi depth is the depth at which the pattern on the Secchi disk is no longer visible and is taken as a measure of the transparency (clarity) of the water.

- Record GPS coordinates of invasive emergent shoreline plants and submersed aquatic invasive vegetation (e.g. curly-leaf pondweed and flowering rush).
- If aquatic invasive vegetation is located, continue surveying upstream until the source (upper-most infestation) is identified.

Survey at high-risk sites located on streams and rivers (e.g. fishing access sites/recreation areas):

- Survey conducted from shore with rake throws and/or underwater viewers, by snorkeling or SCUBA divers.
- Survey in a zig-zag pattern (visual observation and/or rake throws) for 100 meters (300 ft) upstream and downstream from initial access point (be sure to sample riffles, pools and slack-water areas).
- Record GPS coordinates of invasive emergent shoreline plants and submersed aquatic invasive vegetation (e.g. curly-leaf pondweed and flowering rush).
- If aquatic invasive vegetation is located, continue surveying upstream until the source (upper-most infestation) is located.

SURVEY PROTOCOL (GENERAL STATEWIDE ANS):

Contact FWP, ANS coordinator for details on sampling methods for aquatic organisms other than plants.

The field survey and monitoring period for ANS species in Montana is from June through mid-October. Number of sites surveyed and schedule for survey/sampling is based on site risk factors and available funds and resources. Sample sites through the FWP ANS program are selected based on: 1) level of angler/boater use; 2) level of out-of-state angler/boater use; 3) proximity to existing ANS in adjoining states/provinces; and 4) water/site characteristics influencing potential for ANS species to colonize (i.e. calcium levels, substrate, nutrient loading). In general, the primary factor in ranking sites is level of angler/boater use, with higher-use sites on streams, rivers and lakes receiving priority.

A total of about 132 survey sites have been identified by the ANS coordinator. The highest risk sites, such as recreation areas on Canyon Ferry reservoir, and Madison and Missouri Rivers, are surveyed multiple times during the season. Other sites are surveyed annually or biennially depending on recreational use and available resources. Survey/sampling at each site includes: Micro-invertebrates (plankton), macro-invertebrates (i.e. snails, mussels, crayfish), and macrophytes including any submersed aquatic plant such as Eurasian watermilfoil.

Sampling protocol for lakes involves identifying key access points for boaters/anglers and conducting shoreline surveys with particular attention to boat docks. Macro invertebrates (mussels) and macrophytes (aquatic plants) are identified at time of survey. There is no minimum sampling protocol for macrophytes, samples are collected with a rake in areas where submersed aquatic plants are observed at the survey location, and plants identified at time of collection.

Sampling protocol for rivers includes accessing water at fishing access sites (FAS) and searching about 100 meters (300 ft) upstream and downstream from the access point. A zig-zag search pattern across the river or stream is utilized where possible and all habitats sampled (riffles, pools, etc). Samples collected are the same as described for lake sampling for macrophytes on shoreline. Data input and sample analysis are conducted during winter months.

APPENDIX E. PREVENTION MEASURES

AQUATIC RECREATION (FROM CIPM PREVENTION GUIDELINES)

- Post weed awareness messages and prevention practices at kiosks located at watercraft-launching facilities. Guidelines can include some of the following examples:
  - Before transporting to new waters, rinse boat and boating equipment with hot (40°C or 104°F) clean water, clean boat or trailer with a pressure washer.
  - Wash and dry fishing tackle, downriggers, float tubes, waders, and other equipment to remove or kill harmful species not visible at the boat launch.
  - Avoid running personal watercraft through aquatic plants near boat access locations. Instead, push or winch watercraft onto the trailer without running the engine.
  - Waterfowl hunters may use elliptical, bulb-shaped, or strap anchors on decoys because these types of anchors avoid collecting submersed and floating aquatic plants.
  - Drain the water in bait buckets, live wells, and transom wells on land or back into the water from which it was taken.
  - Avoid dumping aquarium water or aquatic plants into local waters.
  - Inspect seaplanes and remove weeds from floats, wires, cables, water rudders, and pump floats; wash with hot water or spray with high-pressure water, or dry for at least five days.
  - Avoid taxiing seaplanes through heavy surface growths of weeds before takeoff; raise and lower water rudders several times to clear off plants.
  - Divers should clean their equipment after each use in water heated to at least 140° F and everything should be allowed to dry completely between dives.
- Consider providing proper washing equipment at major watercraft-launching sites.
- When feasible, inspect boats (including air boats), trailers, and other boating equipment and remove any visible plants, animals, or mud before leaving any waters or boat-launching facilities.
- FWP will clean watercraft used by FWP employees to minimize weed spread.
- When feasible, maintain a 100-foot weed-free clearance around boat launches and docks.
- Promptly post sites if aquatic invasive weeds are found. Confine an infestation; where prevention is infeasible or ineffective, close the facility until the infestation is contained.
- When feasible, construct new boat launches and ramps at deep-water sites. Restrict motorized boats in lakes near areas that are infested with weeds.

WATERSHED MANAGEMENT

- Frequently and systematically inspect and document riparian areas and wetlands for noxious weed establishment and spread. Eradicate new infestations before they become established – effective tools for riparian-area management are limited.
- When possible, maintain conditions (for example, water levels) that sustain desired riparian plant systems that compete effectively with weeds.

- Promote dense growth of desirable vegetation in riparian areas to minimize the availability of landing and germination sites for weed seeds and propagules that might be produced upstream.
- Address noxious weed risks in watershed restoration projects and water quality management plans.
- Pay particular attention to practices listed under "Site-disturbing Projects and Maintenance Programs" in this document.

APPENDIX F. SAMPLE WORDING FOR TEMPORARY SITE CLOSURE

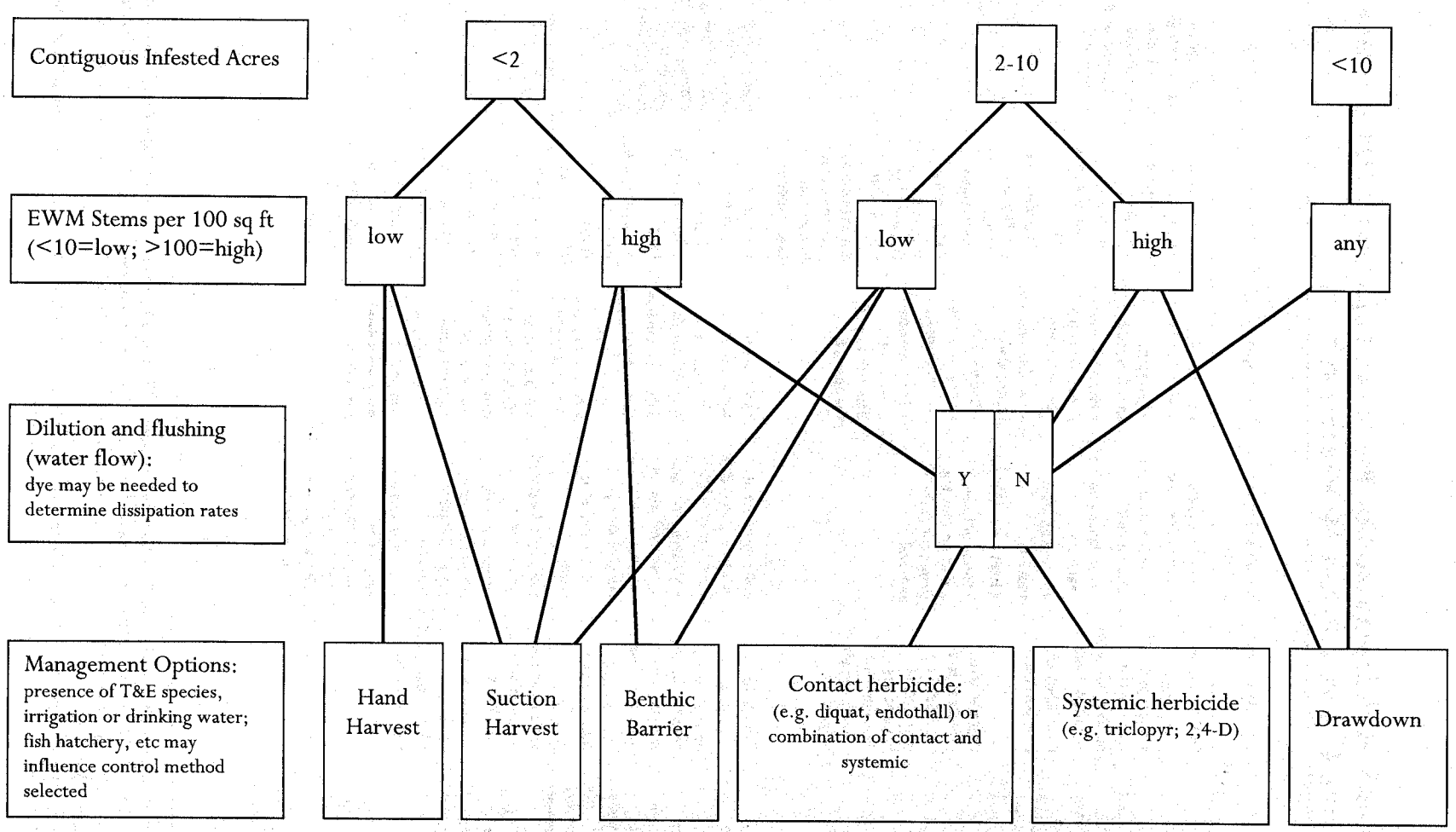
ATTENTION BOATERS

BOAT RAMP CLOSED TEMPORARILY TO MOTORIZED WATERCRAFT

Closure due to presence of
_____, a highly invasive aquatic noxious weed.
Closure effective until further notice.

For additional information please contact:
_____ county weed district
_____ phone

APPENDIX G. MANAGEMENT DECISION TREE (BROADLEAF INVASIVE AQUATIC PLANTS E.G. EURASIAN WATERMILFOIL).14



[14]This decision tree is a guide to help with management decisions, always consult with an expert when treating new aquatic sites. Most effective hand harvest is at densities of ~1-2 plants/100 sq ft (Aquatic Plant BMP Handbook). See herbicide table (appendix____) for trade names, application rates and water use restrictions/guidelines.

APPENDIX H: COMPARISON OF PHYSICAL TREATMENT OPTIONS FOR INVASIVE AQUATIC PLANT MANAGEMENT[15]

Method	Estimated Cost	Factors Promoting Success	Advantages	Limitations	Follow-up	Permits[16]
1. Manual Removal *Divers use hands or hand-held tools to remove entire plant from sediment and water column*	$400/day/diver Plus surface support and containment barriers; less with volunteer labor Plus disposal/ transport costs. Cost per acre estimated to be $150-$300 for new, sparse infestations - dependent on density and plant height	• Small area, low density infestation • Effective fragment containment • Low density native vegetation • Thorough plant spotting • High water clarity • Sandy or loose substrate allowing easier/complete removal	• Can target specific locations • Can target specific species • Has a minimum impact on native flora and fauna • Can be used near obstructions • Can be used where herbicides are not an option • Plants may be composted, depending upon the species	• Is slow, labor intensive, and expensive over a large area • Increases turbidity in short term • Impaired diver visibility can restrict effectiveness • May spread species if fragments are not collected • In high density situations, may impact non-target species	Inspections at least monthly during growing season; new plants removed when found	318 [DEQ] 124 [FWP] [310 private issued by CD]
2. Diver-Operated Suction *Divers use venturi pump systems to suction plants and their roots after removing them manually from the sediment. This approach accelerates manual removal*	$140/hour Cost depends upon plant density, ease of removal, and number of divers. Plus disposal/ transport costs. One suction system can cover approximately 1 acre/week Cost per acre varies from $4,200 to $15,000 depending on density	• Monoculture of invasive species (few or no native plants) • Moderate or high density infestation over relatively small area (<2 acres) • High initial water clarity • Effective fragment containment • Sandy or loose substrate allowing easier/complete removal • Effective surface support for motor/compressor operation, plant collection and turbidity control	• Can target specific sites • Can target specific species • Can be used near obstructions • Can be used where herbicides are not an option • Allows more efficient harvest of denser vegetation than manual removal alone • Plants may be composted, depending upon the species	• Is slow, labor intensive • Increases turbidity in short term • Impaired diver visibility can restrict effectiveness • May spread species if fragments are not collected • May spread seeds and tubers • Could release nutrients into water column to facilitate algae growth	Inspections at appropriate intervals during growing season; new plants removed when found	318 [DEQ] 124 [FWP] 404 [ACE] [310 private issued by CD]

[15] Mattson MD, PJ Godfrey, RA Barletta, A Aiello and KJ Wagner. 2004. Eutrophication and Aquatic Plant Management in Massachusetts: Final Generic Environmental Impact Report. Prepared for the Department of Environmental Protection, Department of Conservation and Recreation, and Executive Office of Environmental Affairs, Commonwealth of Massachusetts by the Water Resources Center, University of Massachusetts. June 2004.

[16] Permits for projects directed by government agencies are 318, 124, and 404. If the project is directed by a private entity, then a 310 permit from Conservation District may be required in place of the 124 permit.

Method	Estimated Cost	Factors Promoting Success	Advantages	Limitations	Follow-up	Permits[16]
3. Bottom Barriers *Semi-permanent materials are laid over the top of plant beds to reduce light and suppress plant growth*	$1.00 sq ft includes cost of material and installation; includes maintenance first year. Additional maintenance $0.25/sq ft/year	• Effective installation that deters barrier from shifting location • Limited boat wake, wave, spring, and current action in water column • Lack of bottom obstructions that can puncture barrier or hinder its installation • Depths ≥ 5 feet best. Need at least 3 ft separation from boats in protected areas w/ no boating action and at least 2 ft separation from surface to avoid ice scouring in winter. • Maintenance responsibility clearly defined	• Kills plants within one to two months • Some materials can be reused; removal for replacement or maintenance is often possible • Targets specific locations • Can be used adjacent to structures or obstructions • Is effective around docks, boat launches, swimming areas, and other small intensive use areas	• Not selective • Impacts non-mobile bottom dwelling organisms; most suitable for <1 acre • Requires maint. for safety and proper performance • Recreationists/ boats may damage or dislodge bottom screens • Improperly anchored screens may create safety hazards for recreationists • Some bottom screens are difficult to anchor on deep muck sediments • Without regular maintenance aquatic plants may colonize screen • Expensive for large areas	• Maintain every 7- 14 days for 30 days, then once a month thereafter during the season of use. Removal within 3 months is preferred to allow native colonization; can leave barrier in place over winter on some sites; must clean before next season or plants root [on top of fabric]	318 [DEQ] 124 [FWP] [310 private issued by CD]
4. Mechanical Harvesting *A large specialized machine, with an underwater cutterbar, is used to "mow" and collect the plants from the top 4-10 feet of the water column*	$200-$800/acre depending upon transport cost, at least for milfoil NOT RECOMMENDED FOR USE IN MT due to fragmentation and incomplete removal of plants					

APPENDIX I: HERBICIDE GUIDELINES FOR INVASIVE AQUATIC WEED MANAGEMENT IN MONTANA BASED ON HERBICIDES APPROVED IN THE STATE[17]

TABLE 1. HERBICIDE GUIDELINES

Aquatic Weed	Treatment	Rate	Comments
Eurasian watermilfoil [perennial dicot]	2,4-D DMA-4IVM systemic	0.5 to 1 gal/ac foot	Do not treat more than half of a lake or pond at one time to avoid oxygen depletion and fish kill. In large lakes, leave a 100-ft buffer strip. Do not treat within ½ mile of potable water intakes. Treat in spring when milfoil starts to grow. Spray on or inject under water.
	Renovate 3® (Triclopyr) systemic	0.7 to 2.3 gal/ ac foot	
	Renovate OTF® (Triclopyr) systemic	20 lb/ surface acre	Application rate is dependent upon mean water depth in the treated area. Potable water set back distances are dependent upon total area treated; consult label for proper set-back distances. Applications should be made in spring or early summer to actively growing plans.
	2,4-D (20% granules) systemic	100 to 200 lbs/surface acre	Best results when applied in spring to early summer during early growth stage. Apply uniformly using portable spreader (cyclonic seeder). Rate depends upon weed species, weed mass, water depth, and water pH. Repeat application if needed. Do not use water for agricultural purposes, watering dairy animals, or domestic purposes.
	Aquathol Super K® (Endothall) contact	0.5 to 2.5 ppmw[18]	Safer to fish than dimethyalkylamine salts. Spray or inject liquids under water. Apply granules evenly with cyclone seeder. Apply as soon as possible after weeds begin to grow and water temperature is above 65F. When treating in sections, treat on a 5- to 7-day interval. Use higher rates when spot treating.
	Sonar AS®: fluridone systemic	0.5 to 4 pt/ surface acre	Fluridone requires a long contact time (more than 60 days) to be effective. A test available from the manufacturer may be advisable for some water bodies to ensure that adequate concentrations of herbicide remain in the water body for effective control.
	Sonar SRP® (fluridone) systemic	10 to 80 lb/ surface acre	
	Diquat contact	1-2 gal per surface acre	Distribute evenly over infested area. Inject or apply on surface of slow-flowing water. Do not apply to muddy water.
Curly leaf pondweed – summer dormant perennial monocot	Aquathol Super K (Endothall); contact	0.5 to 2.5 ppmw	[See comments above for milfoil]. Limited data on efficacy of fall treatments. Spring treatments applied for 2 consecutive years appear effective.
	Sonar AS; systemic (fluridone)	0.5 to 4 pt / surface acre	See comments above for milfoil.
	Sonar SRP (fluridone)	10 to 80 lb / surface acre	
Flowering rush [perennial monocot] [19]	Clearcast® (imazamox) systemic	2 qts/ac	Apply with Competitor® MSO at 2 quarts/acre.
	Habitat® (imazapyr) systemic	2 to 3 qt surface acre or 1% solution	Spray on foliage. Add 1 quart of aquatic-approved nonionic surfactant per 100 gallons of spray solution; or with Competitor MSO at 2 quarts/acre.

[17] Rate and comments sections from JD Madsen (Mississippi State Univ.) and P Rice (University of Montana), personal communications; and Madsen JD. 2010. Weed Control Guidelines for Mississippi, Aquatic Weeds Section. Online <http://msucares.com/ubs/publication>; and Minimum spot treatment size for EWM and CLP is ~1 acre (Tom McNabb, Clean Lakes); Either 308 or MPDES permit required for most applications (see permit section in Chapter 2).

[18] ppmw: parts per million by weight

[19] Herbicides applied at spring drawdown to emerged plants provided good control the season of application but <10% control by mid-summer the following year.

TABLE 2. TREATED WATER USE RESTRICTIONS (NUMBER OF DAYS) FOR HERBICIDES LABELED FOR AQUATIC VEGETATION MANAGEMENT IN MONTANA[20].

Common Name	Trade Name®	Human Drinking	Swimming	Fish Consumption	Animal Drinking	Irrigation Turf	Forage	Food Crops
2,4-D	DMA 4 IVM, Hardball, Navigate, AquaKleen	[ab]	0	0	0	21[c]	21[c]	21[c]
Endothall	Aquathol K, Aquathol Super K, Hydrothol 191 Hydrothal Granlar	7-25[d]	0	0	7-25	0	7-25	7-25
Diquat	Harvestor, Redwing, Reward, Weedtrine	1-3	0	0	1	1-3	5	5
Fluridone	Sonar Sonar SRP and others	0	0	0	0	30	30	30
Glyphosate	Aquapro Rodeo and others	0	0	0	0	0	0	0
Imazamox	Clearcast	[e]	0	0	0	[e]	[e]	[e]
Imazapyr	Habitat, Aquapier, Gullwing	2	0	0	0	120[f]	120[f]	120[f]
Triclopyr	Renovate 3 Renovate OTF	[g]	0	0	0	[h]	120[h]	120[h]
Acid Blue #9 dye	Aquashade	0	0	0	0	0	0	0

[a.] See label distance allowed from potable water intake.

[b.] A shorter interval may be used if an approved assay indicates less than 0.1 ppm 2,4-D.

[c.] Do not use in ditches where water is used to irrigate highly susceptible crops, such as cotton, grapes, and tomatoes unless an approved assay indicates that 2,4-D concentrations are less than 100 ppb.

[d.] The manufacturer suggests a 600-foot potable water application set back.

[e.] Water can be used when an approved assay indicates imazamox concentrations are less than 50 ppb.

[f.] Use restrictions can be reduced if an approved assay indicates imazapyr concentrations are less than 1 ppb.

[g.] Drinking water can be used only when triclopyr concentrations are less than 0.4 ppm by an approved assay.

[h.] If triclopyr residues are determined to be non-detectable by an approved assay, there is no restriction for use of irrigation water on established grasses.

Consult labels for approved adjuvants and for potential changes in use restrictions!

[20]Madsen JD. 2010. Weed control guidelines for Mississippi. Aquatic Weeds Section. Mississippi State University, pg 160. Online: <http://msucares.com/ubs/publication>.

APPENDIX J: COST OF MANAGEMENT OPTIONS

Method	Treatment Cost	Cost($)/Acre Applied*	Areas for use
Physical Treatment			
Diver Dredge	$140/hr, 2 divers, 30 hrs for 1 acre	$4,200.00	Light infestations.
Bottom Barrier	$1/sq ft, + maintenance $0.25/ft/yr	$43,560.00	Best for use in dock/marina areas; isolated beds
Hand Harvest	$400/day/diver + support staff	$5,000.00	Light infestations; cost depends on density optimum EWM is <10 plants/100 sq ft
Biological Treatment			
None available			
Chemical Treatment: Cost is show for label rate range			
2,4-D Liquid	$115 - $230 (systemic herbicide)	$380.00	Quiescent water
2,4-D Granular	$261 - $522 (systemic herbicide)	$670.00	Deep or flowing water
Triclopyr Liquid	$339 - $898 (systemic herbicide)	$950.00	Shallow still water
Triclopyr Granular	$325 - $877 (systemic herbicide)	$1,030.00	Deep or flowing water
Fluridone Liquid	$81 - $710 (may require multiple "bumps")	$1,160.00	Not eligible for use in moving waters
Fluridone Granular	$114 -$666 (may require multiple "bumps")	$1,110.00	Not eligible for use in moving waters
Diquat	$97 - $194 (contact herbicide)	$340.00	Moving waters and spot treatments
Endothall liquid	$116 - $159 (contact herbicide)	$310.00	Spot treatments
Endothall granular	$207 - $277 (contact herbicide)	$430.00	Moving waters and spot treatments

*Cost/acre is only an estimate. Costs can vary widely depending on size of treatment area, water depth, water exchange, level of infestation, and treatment costs.

Costs include estimated raw material and estimated application costs.
Estimates for herbicides assume maximum label rate and $150.00 per acre application costs for herbicide application.
Cost estimates based on 2008 prices. Prices subject to change.

APPENDIX K. TECHNICAL BACKGROUND FOR ESTABLISHED AQUATIC NOXIOUS WEEDS IN MONTANA AND SURROUNDING STATES AND PROVINCES

EURASIAN WATERMILFOIL: MONTANA

Distribution

Eurasian watermilfoil is a perennial dicot native to Europe, Asia, and northern Africa, and is one of the most widespread exotic aquatic plants in North America. Eurasian watermilfoil was likely introduced into the United States intentionally, possibly through the aquarium trade. The plant was first documented in a pond in Washington D.C. in 1942 (Couch and Nelson 1985). By 1950 the species was reported in the Midwest and portions of the West (e.g., Arizona and California), and since the mid 1990s in eastern Washington and the panhandle of Idaho. Eurasian watermilfoil has now been documented in all lower 48 states except Wyoming. Eurasian watermilfoil was added to the noxious weed list in Montana in 2003, and was first confirmed in the state June 19, 2007 in the Clark Fork River in Noxon Rapids and Cabinet Gorge reservoirs. As of this writing, total acreage infested is about 247 acres in Noxon Rapids and 117 acres in Cabinet Gorge. In August 2010 Eurasian watermilfoil was reported in the lower Jefferson River, Toston Reservoir, upper Canyon Ferry Reservoir (e.g., Cottonwood Channel and Pond 4) within FWP Wildlife Management Area, in several locations within Fort Peck Reservoir and in the dredge cuts below Fort Peck Dam.

A reservoir-wide survey was conducted in Noxon and Cabinet Gorge Reservoirs following discovery utilizing a point intercept survey method (Madsen 1999) was conducted in August 2008. The survey quantified presence and location of Eurasian watermilfoil in Noxon Rapids and Cabinet Gorge Reservoirs (Madsen and Cheshier 2009). Native submersed macrophytes, primarily native pondweeds, milfoils, coontail (*Ceratophyllym demersum*), water-buttercup (*Ranunculus aquatilis*), *Elodea canadensis*, and other native submersed macrophytes were growing in association with the invasive Eurasian watermilfoil and other invasive aquatic plants. Cursory surveys conducted in 2009 indicated a spread rate for Eurasian watermilfoil of about 9.8% annually (Madsen personal communication). Table 1 indicates estimated acreage of invasive aquatic plants in the Lower Clark Fork River reservoirs based on a point-intercept survey completed in 2008.

TABLE 1. ESTIMATED ACREAGE OF AQUATIC INVASIVE PLANT SPECIES IN LOWER CLARK FORK RESERVOIRS IN 2008 BASED ON POINT SURVEY*

Reservoir	Cabinet Gorge	Noxon Rapids	Thompson Falls	Total Acres Infested
Eurasian watermilfoil	117	247	0	364
Curly-leaf pondweed	195	401	72	668
Flowering rush**	0[1]	46	28	74

*(Madsen and Cheshier 2009)

**Flowering rush was observed established in Cabinet Gorge, but was not within the point intercept survey.

The littoral zone (shallow water, 0 to 25 ft depth) occupies 40% of Cabinet Gorge, 30% of Noxon Rapids, and 65% of Thompson Falls reservoir (Madsen and Cheshier 2009). This suggests that Eurasian watermilfoil and other invasive aquatic plants (e.g., curly-leaf pondweed) could occupy up to 1,080 acres in Cabinet

Gorge, 1839 acres in Noxon Rapids, and 385 acres in Thompson Falls reservoir, or about a 10-fold increase in existing infestations.

Noxon Rapids reservoir is suspected to be the original source for Eurasian watermilfoil in this reservoir system based on recreational use (Ryce, personal communication). Noxon receives substantially more angling pressure than does Cabinet Gorge (13,893 summer angling days in 2005 as compared to 792) and substantially more non-resident anglers (1,315 summer angler days in 2005 compared to 512). It is likely that Eurasian watermilfoil was either introduced by out-of-state anglers/boaters or by resident anglers/boaters that have had their boats out-of-state. Mechanical raking of aquatic vegetation around boat docks the last several years may have increased disturbance and susceptibility of the site to Eurasian watermilfoil establishment. In addition, continued raking would cause fragmentation of the weed and increase spread downstream.

Eurasian watermilfoil was reported in the Missouri River system in Toston Reservoir in August 2010. Preliminary surveys indicate the plant infests the lower Jefferson River at least 15.5 miles above Headwaters State Park, Toston Reservoir, Cottonwood channel (north end of Canyon Ferry Reservoir), and above and just below Fort Peck Reservoir. Acreage infested is unknown as of this writing, but most infestations in the lower Jefferson and upper Missouri River system appear to occur at depths less than 5 feet.

Biology and Ecology

Eurasian watermilfoil is an evergreen perennial with finely dissected leaves. The plant is typically most abundant in 3 to 12 feet of water (Nichols and Shaw 1986), although it can be found in water up to 30 feet deep (Aiken et al. 1979). The plant's long, rooted underwater stem branches profusely when it reaches the surface of the water. Leaves are whorled on the stem at each node, and there are generally four leaves per whorl. Leaves are finely divided and feather-like in appearance. There are usually 12 to 21 pairs of leaflets. Each leaflet on Eurasian watermilfoil is thin, fine and about ½ inch long (Figure 2). Eurasian watermilfoil is often confused with native northern milfoil, which has 5 to 10 pairs of leaflets. Leaves of Eurasian watermilfoil are limp when held out of water, whereas leaves of northern watermilfoil stay rigid.

Eurasian watermilfoil differs from native milfoils in that it does not form turions, specialized over-wintering structures. Shoots from the previous growing season persist through the winter and new shoots are initiated in fall, but do not elongate until spring (Smith and Barko 1990). In spring, shoots begin to grow rapidly as water temperatures reach about 59F. When plant growth reaches the surface, shoots branch profusely, forming a dense canopy above leafless vertical stems. Typically plants produce small, reddish flowers that emerge several inches above water on a spike grown from the tip of the stem (Aiken et al. 1979), although some populations rarely flower (Madsen and Boylen 1989). Flowers are inconspicuous and are probably wind-pollinated. After flowering, plant biomass declines as a result of stem fragmentation. Plants may re-grow later in the season with additional flowering.

Eurasian watermilfoil spreads both by stem fragments and seed. Individual plants can produce over 100 seeds but germination of seeds rarely takes place. The main reproductive strategy of Eurasian watermilfoil is dispersal of stem fragments during auto-fragmentation (Aiken et al. 1979). Auto-fragmentation usually occurs in late July and August in Montana. During this growth phase, the plant produces roots at nodes, which naturally break from the original plant resulting in floating rooted plant fragments. Fragments can also be produced by wind, waves, and human activity. Fragments (minimum of two nodes and an inter-node) are usually viable, and have been responsible for the rapid spread throughout North America.

Fragments can survive weeks out of water if kept moist and are responsible for spread to non-infested waterbodies.

Light intensity is also a factor determining Eurasian watermilfoil distribution. Turbid water restricts Eurasian watermilfoil to shallow rooting depths with the plant forming a canopy of horizontal stems at the surface (Titus and Adams 1979). In relatively clear water Eurasian watermilfoil grows at considerably greater rooting depths from which it may not reach the surface (Madsen et al. 1989). Eurasian watermilfoil can overtop and shade other aquatic vegetation over a wide range of water levels and turbidity. The plant dominates desirable native aquatic vegetation by initiating growth early in the season and subsequent rapid spring growth (Nichols and Shaw 1986). The ability of Eurasian watermilfoil to photosynthesize and grow at relatively low water temperatures contributes to its rapid growth to the surface in spring and may increase its ability to compete with other species at relatively high latitudes (Barko et al. 1982). The extent to which Eurasian watermilfoil replaces native species differs from location to location. Specific factors contributing to successful invasion by the plant are unknown, and the cause of explosive growth in some systems but not in others has not been determined (Smith and Barko 1990).

Eurasian watermilfoil can grow in a wide variety of habitats and conditions. It occurs in ponds, lakes, reservoirs, and slow flowing rivers and streams. It will grow in shallow or deep water (1.5 to 25 feet), fresh or brackish water, and has a wide temperature and pH range. It grows best in fine textured inorganic soils where it can get plenty of sunlight; however, it also grows well in substrates ranging from poor, sandy sediment to highly organic soils (Aiken et al. 1979, Nichols and Shaw 1986, Smith and Barko 1990).

Eurasian watermilfoil is very susceptible to freezing temperatures (Stanley 1976) and short-term drawdown during freezing temperatures has been successfully used as a control method in some reservoirs (Bates et al. 1985). Table 2 describes factors influencing growth and morphology of Eurasian watermilfoil.

TABLE 2. FACTORS INFLUENCING GROWTH AND MORPHOLOGY OF EURASIAN WATERMILFOIL*

Factor	Influence of factor on Eurasian watermilfoil growth
Water clarity	Low water clarity limits growth to shallow rooting depths and leads to canopy formation. High water clarity allows milfoil growth at greater depths
Temperature	Plants photosynthesize and grow over broad temperature range (59 to 95 F) Maximum growth rate occurs at high water temperature (86 to 95 F)
Inorganic carbon	Plants grow best in relatively alkaline lakes Plant vigor is less in lakes with low alkalinity
Mineral nutrients	Nuisance growth is primarily restricted to moderately fertile lakes or areas with increased fertility. Uptake of nutrients from sediments is an important source of mineral nutrients Major cations and bicarbonate are taken predominantly from water
Sediment texture	Plants grow best on fine-textured inorganic sediments (greater nutrient availability).
Water movement	Vegetative spread of plant fragments is aided by water currents Plant does not usually occur in high-energy environments
Ice scour	Ice scour may exclude EWM from shallow areas of lakes in cold climates
Desiccation and freezing	Desiccation during drawdown is a viable control measure particularly when accompanied by freezing during winter.

*from Smith and Barko 1990

FLOWERING RUSH: MONTANA

Distribution

Flowering rush, a monocot, is the only species in the Butomaceae family and is native to temperate Europe and western Asia (Tutin et al. 1980). It was first noted in North America between 1897 and 1905 along the St. Lawrence River in Quebec (Fletcher 1908; Stuckey 1968), then was reported to be spreading down river by 1918 (Knowlton 1923), and was well dispersed along the St. Lawrence by 1938 (Marie-Victorin 1938). It was first observed in the United States in 1929 around Lake Champlain in New York (Muenscher 1930). In 1949 it was observed on the banks of the Snake River at Idaho Falls (Anderson et al. 1974). By 1967 it was widely distributed into western Lake Erie (Stuckey 1968). The first Flathead Lake report dates to 1964 at Peaceful Bay in the northwest corner of the lake (Rice 2009). As of this writing flowering rush infests an estimated 2,190 acres in Flathead Lake (Figure) and occurs downstream from Kerr Dam on the Flathead River and lower Clark Fork reservoirs. By 1974 it had become extensively naturalized in Canada and the northern parts of the United States (Anderson et al. 1974). In 1997 it was found in Silver Lake in northwest Washington (Rice 2009). From 1999 to about 2007 flowering rush is know to have spread westward throughout Canada and most of the northern tier states (Kartesz and Meacham 1999; PLANTS 2009). In 2008 an infestation was found in the Yakima River (Washington) above its confluence with the Columbia (Rice 2009).

In Flathead Lake, remote sensing and spatial modeling data indicate that 1,039 acres (Table 3) is currently infested in the 0 to 10 foot littoral zone is 1,039 acres (Table 3). Current remote sensing shows high density infestations; thus it is likely that additional low-density flowering rush were not identified. In addition, the extent of the fully submersed flowering rush phenotype located in the 10 to 20 ft littoral zone is not quantified; however it is estimated that an additional thousand acres of the10 to 20 ft deep littoral zone is infested. Combined infestations represent 14% of the 0 to 20 foot littoral zone. There are also 1,536 acres of wetlands immediately adjacent to Flathead Lake. Current investigations of these adjacent wetlands have been limited to a 133-acre block along the north shore (Lorang and Reddish unpublished data). Flowering rush occupied 8.6 acres or 6.5% of that wetland. Projected to all the adjacent wetlands this sample would yield a best estimate of 100 wetland acres currently infested at density high enough to be detected by remote image analysis.

TABLE 3. FLATHEAD LAKE ACREAGE ESTIMATES OF CURRENT FLOWERING RUSH INFESTATIONS AND AREA SUSCEPTIBLE TO INFESTATION BASED ON A REMOTE SENSING SPATIAL ANALYSIS*

Initial Results Spatial Modeling	Current Acreage		Susceptible Acreage	
Habitat	Acres	Infested** Acres	Maximum Acres	% of Lake
0-10-foot Littoral	5,823	>1,039	4,364	3.5
10-20-foot Littoral (estimated)	8,375	>1,000	6,546	5.3
Total	**14,558**	**>2,039**	**10,910**	**8.8**
% Current & Susceptible of the Littoral Zone		>14%	75%	
Adjacent Wetlands	1,536	100	1,536	

*Rice, Reddish, Dupuis and Mitchell unpublished data
**dense infestations with high cover value

Spatial modeling, primarily based on remote sensing and spectral image analysis of lakebed substrate exposed at low pool, suggests that 10,910 acres of the 0 to 20 ft littoral zone are susceptible to infestation which is 75% of the littoral zone and equivalent to 8.8% of the Lake surface area (Rice, Reddish, Dupuis

and Mitchell unpublished data). All of the 1,536 adjacent wetlands acres may ultimately be susceptible, but flowering rush displacement of the native macrophytes is occurring at a considerably slower rate than flowering rush establishment in previously non-vegetated littoral zones.

Flowering rush rhizomes are discharged through Kerr Dam into the lower Flathead River and to the Clark Fork reaching at least the Clark Fork delta at the head of Lake Pend Oreille. Current acreage estimates for downriver impoundments are Thompson Falls 28 acres, Noxon 46 acres, present at trace levels in Cabinet Gorge (Madsen and Cheshier 2009), and 8 to 200 acres at Lake Pend Oreille (Madsen and Wersal 2008, Tom Woolf personal communication). There are current quantitative estimates for flowering rush in the Flathead and Clark Fork rivers, but the plant is present in sloughs, backwaters, and low flow areas proximal to boat launch sites.

Flowering rush has been drawn out of the Flathead River at the Pablo Reservoir lift station and is currently being redistribution through the Flathead Valley irrigation system. A disjunct population was reported in Salmon Lake in 2001, but inspections of Salmon Lake, Montana in 2007 and 2008 have not confirmed the initial report.

Biology and Ecology

Anderson and others (1974) recognized three areas of flowering rush infestations in North America and suggested that because of morphological and size differences the St. Lawrence River populations, Great Lakes populations, and western United States-Idaho Snake River populations possibly came as three separate introductions. The four sexually sterile triploid genotypes found in North America were closely related to native genotypes from the Netherlands and northern Germany (Kliber and Eckert 2005). Kliber and Eckert's (2005) genetic evidence further suggested that the introduction of these triploids to North America was facilitated by export as horticultural plants from the Netherlands to North America. Kliber and Eckert (2005) also detected two sexually fertile diploid genotypes in North America; but their investigation did not clearly match the two North American diploid genotypes to any of the genotypes they had sampled in the native Eurasian range.

This aquatic macrophyte has emergent and fully submersed phenotypes. The emergent form with rigid vertical leaves is present in Flathead Lake at full pool depths to ten feet. A fully submersed form with lax leaves that wave in the current is present at full pool depths of 10 to 20 feet. The rigid leaves of the emergent phenotype are up to six feet long and the lax leaves of the submerge phenotype can reach ten feet in length and float up to the surface. The leaves are distinctively triangular in cross section. Flowering rush is a non-persistent emerged macrophyte. After the leaves senesce in the fall they collapse to the lake bed unlike cattail and bulrush, which remain erect throughout the year. The inflorescence of flowering rush has an umbel-like form with usually 20 to 50 individual three-petal plus three-sepal pink flowers on five-inch long pedicles arising from a round flowering stalk.

The most relevant morphological feature of flowering rush is a rhizome approximately one foot long that can form branches from lateral rhizome buds. These are clonal infestations and individual plants are called ramets. The karyotype present in Flathead Lake is known to have a mean of 22 rhizome branches per ramet (Lui et al. 2005). A study of a European population revealed that individual flowering rush ramets produced an average of 196 lateral rhizome buds over a six-year duration (Hroudova 1989).

Depending on karyotype and genotype flowering rush can reproduce and be dispersed in four forms: seeds, vegetative bulblets formed in the inflorescence, vegetative bulblets formed on the side of rhizomes, and larger lateral rhizome fragments. Seeds allow long distance dispersal from one water body to another, and

the plant is sold globally to people doing water gardening. The rhizome bulblets, inflorescence bulblets, and rhizome fragments facilitate spread within an infested water body.

Kliber and Eckert (2005) determined that Flathead Lake flowering rush were a triploid karyotype. Although about one in a thousand of the triploid ramets can produce a flowering stalk, these flowers are sterile (Eckert et al. 2003; Rice, Dupuis and Mitchell unpublished data). This Flathead Lake triploid genotype also does not produce a significant number of bulblets in the inflorescence or on the rhizome (Rice, Dupuis Mitchell unpublished data), a local observation that is consistent with the reports for this triploid elsewhere in North America (Thompson and Eckert 2004, Lui et al. 2005). Reproduction and subsequent dispersal by this Flathead Lake sterile triploid is entirely by rhizome fragmentation.

Rhizomes fragment easily, with lateral rhizome buds developing a constriction between the bud and the main rhizome. This constriction allows lateral rhizomes to break off by flowing water, waves, ice scour, passing boats, waterfowl, animals and any other disturbance of the littoral zone and the rhizome mat (Marie-Victorin 1938). The same disturbances, including waterfowl feeding on the rhizomes, break the rhizomes into pieces. The buoyancy of rhizome propagules facilitates dispersal (Marie-Victorin 1938). Although the total number of propagules is lower from sterile triploid in Montana, the potential for establishment from rhizome fragments is likely greater because of the high amount of stored carbohydrate to facilitate expansion of the initial root system.

Water level drawdown above non-vegetated sediments allows flowering rush establishment from previously floating rhizome fragments. Wave action also deposits rhizome fragments along the shoreline. Fine sediments (Rice, Dupuis, and Reddish unpublished data), particularly silty substrates, and current speeds less than two miles per hour enable rhizome fragments to root and establish new plants. In addition, the warmer temperatures exposed sediments or the water/sediment interface at shallow depths promotes root development, leaf sprouting and rapid growth of rhizome fragments. Warmer sediment and shallow water column temperatures also promote regrowth from established rhizomes and lead to stand thickening (Hroudova et al. 1996, Delisle et al. 2003). Any subsequent year drawdown allows flowering rush populations to be renewed by vegetative reproduction (Hroudova et al. 1996). The Kerr Dam hydroelectric facility on Flathead Lake is operated to reach low pool in early spring, whereas a natural lake would reach low pool in late summer. This unnatural late winter/early spring drawdown creates seasonal conditions favorable for establishment of flowering rush infestations in previously non-vegetated littoral zones. In littoral zones and wetlands that are populated with native vegetation, flowering rush has a phenological and hydrologically derived competitive advantage over native macrophytes, which have evolved to a hydrologic cycle with a late summer low pool. Sloughs, backwaters, and other areas with slow current speeds and fine sediments allow establishment of flowering rush in rivers.

CURLYLEAF PONDWEED: MONTANA

Distribution

Curlyleaf pondweed is an invasive perennial monocot aquatic native to Eurasia, Africa, and Australia. It was accidentally introduced to United States waters in the mid-1880s by hobbyists who used it as an aquarium plant, and is now present in all of the continental United States except Maine and South Carolina (GIS 2006). In Montana, the plant was first reported in Ninepipe Reservoir, Lake County, in 1974 (Invaders database) and in Sanders County in 2001. The plant was declared noxious in Sanders County in November 2008 and as a Priority 1B weed statewide in 2010. The extent of curly-leaf pondweed in Montana has not been quantified; however it has been reported in water bodies both east and west of the continental divide.

Inventories conducted in Noxon Rapids, Cabinet Gorge, and Thompson Falls reservoirs in Sanders County in 2008 indicate 668 acres infested in the three reservoirs Table 1. As of this writing, the weed is reportedly established in the Gallatin River, and upper and middle sections of the Missouri River including Toston, Canyon Ferry, Holter and Hauser Reservoirs. Total acreage and distribution statewide is unknown.

Biology and Ecology

Curly-leaf pondweed is considered a deep-water plant, but will colonize in shallow water. With a strong rhizome anchoring system, curly-leaf pondweed can grow in a variety of different aquatic sites and sediment types. This plant can tolerate extreme conditions including low light and cold water temperatures. Curly-leaf pondweed actively grows during winter months when most plants are dormant, making it one of the first aquatic plants to emerge in spring. These tolerances allow populations to out-compete native plants in spring. Curly-leaf pondweed reaches its maximum density in late spring and dies back in mid-summer when most plants are at peak seasonal growth. Although this plant can reproduce by seed, its main reproductive means is through burr-like winter buds (turions), which are moved among waterways. Turions are produced in early to mid-summer in Montana, just before the plant begins to die. Turions remain dormant in sediment through summer until cooling water temperature triggers germination in fall; however, turions can germinate throughout the winter and into spring. Germination rate of turions is between 60 to 80 percent. Plants will also grow from rhizomes of established plants.

Dispersal and spread of the plant to non-infested sites is mainly through transport of turions on aquatic equipment such as boats and trailers. Once established, an individual plant can produce hundreds of turions that can be transported by water currents and wave action throughout a water body.

INVASIVE AQUATIC PLANT STATUS: ADJOINING STATES AND PROVINCES

British Columbia, Canada

Eurasian watermilfoil was first observed in British Columbia in 1970 in Okanagan Lake. The plant spread to Shuswap and Mara Lakes, to Christina and Champion Lakes in the Kootenays, to all the main lakes in the Okanagan Valley, and to numerous water bodies in the lower mainland. Isolated populations were also discovered on Vancouver Island in 1985, and in Nicola Lake in 1991. Many non-infested water bodies in these areas and elsewhere in British Columbia remain susceptible to introduction of this plant (British Columbia Gov. Report 2004). The proximity of Eurasian watermilfoil infestations in British Columbia to the Montana border is unknown; however it is likely that the weed occurs in the Kootenai River system north of Eureka, Montana.

British Columbia had the premier Eurasian watermilfoil program in North America during the early- and mid-1980s. Funding for the program was halted during a budget deficit in the late 1980's, and no province-wide program has been active since that time. There is no person dedicated to Eurasian watermilfoil at the provincial level, but individuals are managing "nuisance growth," mostly by rotovating or harvesting (Madsen, personal communication).

Flowering rush and curly leaf pondweed have been reported in British Columbia, Canada but details have not been compiled (PLANTS 2009).

Alberta, Canada

Eurasian watermilfoil, flowering rush, and curly-leaf pondweed have been reported in Alberta, Canada but details of infestations have not been compiled (PLANTS 2009).

Saskatchewan, Canada

There are no known locations of curly-leaf pondweed or Eurasian watermilfoil in Saskatchewan (Chet Neufeld, Native Plant Soc., Saskatchewan). Flowering rush currently occupies about one acre in Saskatchewan, near the town of Watrous. The plant is currently being managed on a volunteer basis with permission of the landowner. Clipping flower heads will continue, and digging rhizomes may be done if there is enough help. Currently, Canada does not have an herbicide approved for flowering rush, or for use in water. Flowering rush is currently not covered by law as it is not on the noxious weed list for Saskatchewan; however, it will be added with the update that the weed list is currently undergoing.

Idaho

Eurasian watermilfoil was first reported in the northern part of Idaho in Bonner County in 1998 where it infested three waterways. The weed was subsequently discovered in Payette Lake (Valley County), followed by other counties in southwest Idaho. By 2000 Eurasian watermilfoil was considered a widespread weed in northern and southwestern Idaho (Idaho Invasive Species Council 2008). The northern region has the most abundant and highest-density infestations of Eurasian watermilfoil, some of which are in Cabinet Gorge reservoir adjacent to Montana's western border. In 2006 Idaho implemented an aggressive statewide program to contain, control, and eradicate Eurasian watermilfoil in the state. The Idaho State Legislature and Governor approved $4 million annually ($12 million total) starting in 2006, for eradication of Eurasian watermilfoil in Idaho.

Flowering rush is present in Lake Pend Oreille, and there are a number of known infestations in the Snake River from Idaho Falls to American Falls (Rice 2009). The Aberdeen-Springfield Canal system, which provides sprinkler irrigation water for potatoes and other crops in southeast Idaho, has significant infestations in about 150 miles of the 300 miles of high delivery volume canals (Howser, personal communication). There are reports of smaller infestations in other irrigation systems in that area.

Curly-leaf pondweed has wide distribution in Idaho, but many water bodies are not infested. The weed is present in the Snake River from Idaho Falls westward, in the Payette River from Horseshoe Bend downstream, the Boise River downstream from Boise, Bruno River, Lake Pend Oreille and the Clark Fork River system, Hayden Lake, and Kootenai River. As of this writing, curly-leaf pondweed was not present in Henry's Lake (near Montana border), Lake Coeur d'Alene, or the Priest River system.

Hydrilla is present in southwest Idaho in thermally-influenced waters. The plant is targeted for eradication in Idaho.

North Dakota

Eurasian watermilfoil was first reported on the Sheyenne River, immediately downstream of Valley City, North Dakota, in 1996 (USGS 2008), but was not found in 1997 following flooding and drawdown (Engel 1999). As of this writing, the weed occurs in Dead Colt Creek (Ransom County) and Sheyenne River (Barnes and Ransom Counties) (ND Department of Agriculture, personal communication). Eurasian watermilfoil occupies less than 10 acres on the Sheyenne River and infestations are controlled with

herbicide treatments (McAllister, personal communication). Both counties are located in eastern North Dakota, about 300 miles east of Montana's state line.

Curly-leaf pondweed is more widespread than Eurasian watermilfoil in North Dakota and is located along the Missouri River and associated reservoirs near Montana's eastern border and in other areas of the state. Flowering rush has been reported but details of infestations have not been compiled (PLANTS 2009).

South Dakota

Eurasian watermilfoil was reported in Lake Sharpe, a Missouri River main-stem dam in central South Dakota, in 1999 (Andy Burgess, personal communication). Lake Sharpe is located near Pierre, South Dakota and approximately 200 miles from Montana's eastern border. The weed is dispersed throughout the 82-mile reservoir but as of 2007 has not established large mono-culture stands. Turbid waters and high wave action may be reducing potential for Eurasian watermilfoil to form dense mats of vegetation on the surface, which would impede fisheries and recreation.

A second infestation of Eurasian watermilfoil was reported in Lake Oahe, a Missouri River reservoir immediately upstream from Lake Sharpe (Andy Burgess, personal communication). Fisheries staff have not found Eurasian watermilfoil in samples collected during lake surveys in other waters. Transport of Eurasian watermilfoil in South Dakota is prohibited by plant quarantine status, and the plant has been the target of public information campaigns since 1992.

Flowering rush is present in Faulkton Lake and Lake Louise in north central South Dakota (Faulk County). As of this writing, a suppression effort is planned based on available funding (Peter Rice, personal communication). Curly-leaf pondweed is widespread in the state, but there is no management criteria established for the plant. Although curly-leaf pondweed is on the state ANS watch list, it is not perceived to have a significant impact to fisheries or recreation since the plant dies early in the summer.

Wyoming

There are no reports of Eurasian watermilfoil or flowering rush occurring in Wyoming as of this writing (Slade Franklin, personal communication). In 2008, six lakes and 22 popular river access sites in Teton County, Wyoming were surveyed for aquatic invasive species, including Eurasian watermilfoil and curly-leaf pondweed (Sytsma and Howard 2008). Results of the survey show that none of the target aquatic species were detected, but continued surveillance is required. The program is scheduled for expansion in 2009 utilizing Wyoming Game and Fish biologists and USDA Cooperative Agricultural Pest Survey (CAPS) to conduct aquatic invasive species surveys. As of this writing, Wyoming is developing an ANS plan that will include management of aquatic plants. Curly-leaf pondweed has been reported but details of infestations have not been compiled (PLANTS 2009).